SCIENCE

FRIDAY, APRIL 11, 1913

CONTENTS

Genetics and Breeding: PROFESSOR RAYMOND PEARL 539

The Metamorphosis of the Carnegie Foundation: PROFESSOR ARTHUR O. LOVEJOY 546

George Harold Drew: PROFESSOR ALFRED G. MAYER 552

Fur Seal Legislation: PRESIDENT DAVID STARR JORDAN, GEORGE ARCHIBALD CLARK 553

The Eugenics Record Office 553

The National Academy of Sciences 554

Scientific Notes and News 555

University and Educational News 558

Discussion and Correspondence:—
Electromagnetic Induction and Relativity: DR. S. J. BARNETT. *A Labeling Surface for Laboratory Glassware:* DR. A. F. BLAKESLEE. *Most is—What?* PROFESSOR F. W. MARTIN 560

Scientific Books:—
Northrup on Methods of Measuring Electrical Resistance: DR. FRANK WENNER. *Babcock's Metabolic Water:* PROFESSOR RAYMOND J. POOL. *Carrington on Fresh Air and how to use it:* DR. HENRY SEWALL 562

Scientific Journals and Articles 565

The Influence of Various Educational Institutions upon the Development of Agricultural Science: PROFESSOR R. W. THATCHER 566

Special Articles:—
The Distribution of Occidental Spiders: DR. FRANK E. LUTZ 567

The American Association for the Advancement of Science:—
Section D: G. W. BISSELL 568

Societies and Academies:—
The Helminthological Society of Washington: MAURICE D. HALL. *The Anthropological Society of Washington:* W. H. BABCOCK. *The Clemson College Science Club:* F. R. SWEENY .....

MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

GENETICS AND BREEDING[1]

ONE of the primary purposes for which the American Breeders' Association was founded was to bring together on a common ground those who were approaching the problem of the improvement of plants and animals by breeding, on the one hand, from the side of practical breeding, and, on the other hand, from the side of the scientific study of heredity. One of these groups stands as the representative of the art or craft of breeding, and the other as the representative of the science of genetics. That each of these two bodies of men has something to learn from the other there is no doubt. Even with the continued and prosperous existence of such an association as this it is certain that actually there is far from being anything like as extensive a mutual interchange of knowledge and opinion between science and practise in breeding as would appear from every point of view to be desirable.

It will have been perceived by all who have followed my remarks so far that they have been commonplace to the point of utter banality. They constitute a thoroughly bromidic introduction to a conventional treatment of that time-stained and battle-scarred old theme of compulsory oratory, the relation of science and practise. Every one can foresee, with a moment's reflection, just what ought to come next, and next, and on to the end. At the outstart should be set forth the great achievements

[1] Papers from the Biological Laboratory of the Maine Agricultural Experiment Station, No. 44.

Address of the retiring chairman of the Animal Section of the American Breeders' Association at its Columbia, S. C., meeting in January, 1913.

of the science of genetics; then the tremendous possibilities thus opened out to the practical breeder, who in the near future will be able to soar from this scientific foundation to realms of wealth and power in the community hitherto possible only to the predatory classes; nevertheless, in a meek and humble spirit of gratitude engendered by the blessings which have been poured at his feet, he in turn contributes to the great cause of science by placing at the disposal of the geneticist the wonderful stores of experience he has accumulated; at the end should come an impassioned plea for "getting together" for the good of agriculture, humanity and sundry other things, which should, if well done, so titillate the emotions as to send everybody home uplifted, and, in general, determined to lead a better life.

I have sketched this little picture, which, if necessarily impressionistic, is essentially true, only to bring into sharp relief the intellectual junction point, at which we shall alight and change cars. Just because there has been so much perfervid oratory, loose thinking and cheap advertising of the achievements of men and institutions based on the ideal or assumed mutual interrelationship of the science of genetics and the breeders' art, it seems worth while to make a careful objective analysis of the actually existing relations between these adjoining fields of human endeavor. Such an analysis will be attempted in what follows. Specifically the question to which attention is invited is: What essential and fundamental contributions has genetics made to the *practise* of the breeders' art? Or, to put the matter in another way, what particular things does the most highly successful practical animal breeder do now which he did not do, or performed differently, before Mendelism was rediscovered or Darwin wrote?

It is generally agreed that during the past fifteen years there has been a great advance in our knowledge of the fundamental laws of heredity. Indeed, it may fairly be said that more has been gained in this regard within this period than in the entire previous history of this field of knowledge. The new method of investigating heredity which was given by Mendel's work has for the first time made a real analysis of genetic phenomena possible. It was a truly imposing array of organisms and characters which Major Hurst was able to list at the meeting in commemoration of Mendel at Brunn, as comprising those attributes of organisms about the inheritance of which something *definite* is *known*.

There is a very widespread assumption that coincident with this advance in our knowledge of the fundamental laws of inheritance there has been an equal advance in the practical art of breeding. This has perhaps resulted from the somewhat overenthusiastic prophecies of the early Mendelian workers. Many will remember the glittering possibilities set forth to the practical breeders in the early meetings of this association. They were told in effect that at last the key to the genetic riddle had been found; that by the application of these simple Mendelian laws existing races of animals could be brought up to desired ideals with more certainty and despatch than had hitherto been possible, and that new races could be created which would surpass in usefulness anything now existing. There was, of course, an element of truth in all this. But it raised unwarranted hopes in the minds of many laymen. The apparent failure of these prophecies to be realized has probably done real harm to the cause of science in the minds of some practical men—representatives of the class to which in last analysis science must look

for its material support—and very generally has led animal breeders to under-rate the real value of Mendelian investigations.

It is permissible to think that the fundamental error involved was in the assumption we are all inclined to make that any distinct advance in science necessarily means an equally marked and immediate advance in the practise of the associated art or craft. It is extremely difficult for the man of the laboratory or the study, as he takes a broad view of the history of the industrial arts, and sees that great progress there has rested upon fundamental scientific discoveries, to realize that the art of breeding differs essentially in this respect from the industrial arts. The breeding of animals by man for more or less definite purposes goes back to prehistoric times. Practically as soon as primitive man began the domestication of animals he must perforce have begun, in greater or less degree, to control their breeding. Having started thus early, the craft of breeding had attained a relatively high degree of development centuries before any attempt was made to formulate the scientific principles of genetics. As an example may be mentioned the breeding of horses in England. It is customary to think of "stallion laws," aimed at the improvement of the horses of a state, as very modern and American, and an indication of the influence of the science of breeding on the practical craft. But three hundred and seventy odd years ago, in the reign of Henry VIII., there was passed a "bill for the breed of horses," which in its preamble stated that:

> Forasmuch as the generation and breed of good strong horses within this realm extendeth not only to a great help and defence of the same, but also is a great commodity and profit to the inhabitants thereof, which is now much decayed and diminished by reason that, in forests, chases, moors and waste grounds within this realm, little stoned horses and nags of small stature and of little value be not only suffered to pasture thereupon, but also to cover mares feeding there, whereof cometh in manner no profit or commodity.

In order to prevent the multiplication of poor specimens section 2 of this law provided that no uncastrated stallion two years or more old which was under 15 "handfulls" high should be allowed to graze on common or waste land in certain counties. Further it was provided in section 6 that all forests, chases, commons, etc., were to be "driven" at a stated time in the year (just preceding Michaelmas day) and all horses, mares and colts which were not of good quality, or did not promise to become or to produce serviceable animals, were to be killed.

The fact is that the practise of the art of animal breeding, so far from languishing, for want of instruction from the science of genetics, is actually immeasurably in advance of that science. The geneticist who is disposed to think otherwise should visit a great horse, or cattle, or even poultry show, and then permit himself to consider candidly the question whether with all his science he could himself breed, or tell any one else how to produce, *finer* specimens than he will see there. Yet by hypothesis that is exactly what he ought to be able to do, if genetics is to set up as a teacher and guide to the best practical methods of live-stock breeding.

It is capable of abundant historical proof that many years ago, before the beginning of the world movement towards agricultural education, experimentation and the grounding of a science of agriculture in general, there were in existence individual animals (even flocks and herds), and strains of seeds or farm crops which were probably intrinsically as fine, as productive, and generally as excellent as any that we know to-day. Given as intelligent care and feeding as our prize-winning animals

and plants now get, there is every reason to believe that they would have equalled or surpassed our finest specimens of to-day. Some specific examples may be cited. Mr. Geo. A. Scott,[2] of Nashville, Tenn., had in 1863 "a common scrub cow" which produced in one year 1,447½ gallons of milk. Taking the weight of one quart of milk at 2.15 lbs. as sufficiently close for practical purposes, this gives a record of 12,448.5 lbs. of milk for the year. This is a respectable figure even for present standards. Going back a half century earlier we have the record of a Sussex cow[3]: "a cow not of either of the highest improved English breeds—long horns or short horns; but of the proper old Sussex breed." The following record is of her production in five successive years beginning in 1805. I have transposed quarts to pounds by the use of the factor given above—2.15.

	Weeks in Milk	Lbs. of Milk	Lbs. of Butter
First year	48	10,580.2	540
Second year	45½	8,894.6	450
Third year	51½	12,366.8	675
Fourth year	42½	9,070.9	466
Fifth year	48	11,543.4	594

Facts of the same sort are at hand for crops. Justin Ely, Esq., of West Springfield, Mass., in 1816, raised 50 bushels of wheat to the acre. Col. Jas. Valentine, of Hopkinton, raised 128 bushels of "Indian corn" to the acre. Payson Williams, Esq., of Fitchburg, raised 614 bushels of potatoes to the acre, and James Whitton, Esq., of Lee, raised 85 bushels of oats to the acre. The average yield of oats to-day is approximately 36 bushels to the acre. The Maine Agricultural Experiment Station, in its tests of the best commercial varieties of oats procurable in this country and Europe, has never been able to obtain a yield per acre of more than 76 bushels.

I have elsewhere discussed records of egg production in poultry in this connection. From 1836 there is an authentic record of crested Polish fowls producing an average of 175 eggs each per year. This was long before the trapnest had been discovered.

Too much stress, of course, should not be laid on such examples as these. They do not indicate that there has been no advance made by the breeder in the qualities of domesticated animals and plants during the last century. The *average* quality of live stock and of crop plants is constantly improving, not only as a result of breeding, but also because of better and more widely disseminated knowledge of how to provide the food and environmental conditions best suited to bring to full expression the potential hereditary capabilities[4] of the individual. I think that such records, however, do fairly indicate that in the practise of the art of breeding there has been no such marked fundamental advance in recent years as there has been in the science of genetics. By empirical methods man has been steadily improving the quality of live stock for centuries past, and long ago a *relatively* high level was reached by the most skillful breeders.

Purely empirical methods are wasteful and slow in operation, but they may attain excellent results. When they are successful it is obviously because at just that point the practise was, by chance, in exact conformity with the underlying principle or law concerned. More generally it may be said that all progressive success of em-

[2] *The Cultivator and Country Gentleman*, Vol. 28, p. 401, 1866.

[3] *Massachusetts Agricultural Repository and Journal*, Vol. IV., No. 4. Cf. also *New England Farmer*, Vol. III., p. 305, 1825.

[4] Consider in this connection the practises of the real expert in making world's records for milk and butter fat production in the seven- and thirty-day advanced registry tests of the Holstein-Friesian breed.

pirical methods depends on a gradual elimination of those operations or practises which do not accord with basic natural laws. In the consideration of the science and practise of breeding this has sometimes been forgotten. It is difficult to remember always that a law of nature may be presumed to have been in operation before its discovery. If Mendel's law represents a real and fundamental law of nature, as certainly appears to be the case in the light of present evidence, it is quite certain that it did not begin operation in A.D. 1900. Whatever of success has been attained during centuries past in the breeding of improved strains of animals and plants, must have been attained by methods and practises which were not violently in discord with Mendelian principles. A nomad Arab may never have heard of the principle of segregation, but none the less he had to reckon with the phenomenon in breeding his horses.

Looking at the matter in this way, the reason is clear why the rediscovery of Mendel's work and the brilliant genetic researches which have followed did not and could not have had any profound revolutionary effect on the *practise* of the animal breeders' art. By years—even centuries—of "trial and error" methods, breeding practise has been brought into rather close conformity with the basic laws of heredity. The discovery of some of these laws by the geneticist could not radically change the breeder's way of attaining results.

What then has the rapidly developing science of genetics done for the breeder and what can it do? Still looking at the matter from the standpoint of the practical animal breeder, it must be agreed, I think, that the chief contribution of recent discoveries in the field of inheritance is that they have brought to light and fairly established certain general principles which enable him in greatly increased measure to understand and interpret his methods and his results.[5] This may seem too mild a statement of the practical value of genetic science to the animal breeder. It undeniably does lack the grandeur of the vision sometimes opened out by the extension lecturer in his zeal to inspire the farmers to better things, and at the same time pave the way to increased appropriations for his institution. But to help one to understand and to interpret is, after all, no mean achievement. It signifies that, with much economy of effort, the successful breeder may dispense with the merely trivial and unessential in his empirical methods, and more directly and uniformly attain the same or a greater measure of success than before. To his less successful brother and the beginner, it means a surer and more rapid guide than the old tradition based on empiricism. It is certain that the young man starting out to-day to be a breeder of fine cattle, of fine horses, of fine chickens, will attain his goal much sooner if he thoroughly understands the meaning of those laws of inheritance associated with the name of Mendel.

The most important general principles which the scientific study of genetics has firmly grounded are, it seems to me, these:

(*a*) That the fundamental basis of all inheritance is to be found in the germinal constitution of the individual rather than

[5] This is of course to be understood as a general statement. There are now a few specific instances, and in time there will be more, where the geneticist has been able to show the breeder precisely how to attain a particular result in breeding commercially for a particular quality, which result he had only hitherto been able to obtain by chance. In no such case, however, so far as I am aware, has the new method been so essentially different from former practise as to be fairly regarded as "revolutionary."

in the body or soma. Those qualities alone are inherited, which are innate in the germ cells, the ova and the spermatozoa. Here only can the breeder find the means with which to accomplish his ends. However interesting theoretically may be those rare and still doubtful cases in which extraordinary influences acting upon the body under the controlled and special conditions of the laboratory may perhaps influence the germ cells through the soma, they have no bearing on the practical conduct of the breeders' craft. Genetics has demonstrated that he may cast aside, for once and all, that mass of tradition and superstition which assumes that influences specifically affecting the body will specifically modify subsequent generations. Has not genetics done breeding a service of great value in freeing it of the sinister influence of "telegony," "saturation," "maternal impressions" and similar sorts of nonsense?

(*b*) That specific characters or groups of characters, in the great majority of cases and perhaps all, are inherited as discrete and definite units. If one mates a pea-combed fowl with a single-combed, all the offspring will have pea-combs. This result occurs whether the pea-combed parent is a Game or a Brahma; whether it is a male or a female; whether it is a strong, vigorous individual, or the sickliest, weakest scrub in the flock. In other words the *kind of bird* it is whose germ cells carry the potentiality to make pea-combs develop in the offspring, so far as we now know has nothing to do with the *specific* result (*i. e.*, the production of a *pea* comb, rather than a single, a rose, or any other kind). Comb form is inherited as a discrete unit uninfluenced by the individual's other attributes. This discovery that characters are inherited as separate units—and no principle of genetics is more firmly grounded than this—gives the breeder a totally new concept of the meaning of "purity" of blood in breeding. We see now that properly (*i. e.*, biologically) one can only speak of an animal as being "pure-bred" when he specifies the particular *character* to which he refers. A chick may be the veriest mongrel in all other respects and yet carry in the germ cells only that potentiality in respect to comb form which leads to the development of a pea-comb. Then however much of a mongrel it may be in respect to all other characters, it is "pure" and "pure-bred" so far as concerns comb. Is it not a contribution of moment to the breeder to have demonstrated that in his breeding operations he may safely and surely deal with individual characters, and groups of correlated characters as units?

(*c*) That in a very great range of cases, perhaps in all—the number of known cases daily grows larger—the Mendelian law of segregation and recombination of characters operates. In the formation of the germ-cells of an individual there is a sorting out or segregation of the hereditary characteristics contributed by the father and the mother and a readjustment of these into all of the combinations, both old and new, which are mathematically possible. What may be the precise cellular mechanism or basis of this wonderful process is not altogether certain, but the phenomenon itself is as certain as the phenomenon of gravitation. It operates as well in regard to the minutest heritable differences in the pedigreed specimens of the same sub-breed as in the wide differences of true hybridization. Properly understood, it enables the breeder to interpret and weigh the results of his breeding operations, and so intelligently to plan the next steps with a certainty and precision hitherto unattainable. Is not this a real contribution of science to practise?

(*d*) That the germinal bases of heritable unit characters can be changed or altered in any respect, only with the greatest difficulty, if at all. It is, I believe, fair to say that there is at present no critical, unchallenged evidence that any alteration can be produced. This matter has recently been discussed in a most able manner by East.[6] The weight of evidence at present indicates that selection does not act in the manner it was long supposed to, in accordance with Darwin's interpretation. It appears that selection, however stringent or long continued, is powerless to alter in any way the original potentialities of the germinal basis of a unit character. Selection appears to be essentially a process of sorting out from a mixture of heritable variations what is already there, and not a germinally creative or germinally additive process.

So far this discussion has been approached from the standpoint solely of animal breeding. It is perhaps allowable, even before this animal section, to digress for a little and discuss plant breeding. The ultimate objective point of the animal breeder is the same as that of the plant breeder, namely the greatest possible improvement of animals and plants and their adaptation to the needs of man. The practical method of working towards this goal is, however, somewhat different in the two fields. The animal breeder almost exclusively works towards the amelioration of existing fixed and "pure" breeds. Especially among the larger domestic animals such a thing as a *new* breed is brought forward by the breeder only on very rare occasions. Almost all of our existing breeds of horses, cattle, sheep and swine have long histories as "pure breeds," and no new ones are being added now. With smaller animals such as poultry the case is of course somewhat different. There we have no registered pedigrees and, with some difficulty, new breeds may be launched.

The plant breeder, on the other hand, makes nearly all of his improvements by the production of new varieties. This he does either by hybridization, actually building up a new type, or by isolation of superior pure-breeding forms from already existing mixtures. He is not hampered by a body of tradition that only the "pure bred" is of any particular value. Almost if not quite every one of the most valuable strains of agricultural plants to-day carries the "bar sinister." To the animal breeder they would be "grades" or "crosses" however gametically pure and only with the greatest difficulty would ever have gained a chance to show their worth.

No one would deny that the systems of registry for live-stock and the exploitation of the "pure-bred" have been of great value in the development of the animal industry of the world. They certainly have; and every day the economic importance of the system becomes greater, for obvious reasons. All systems of pedigree registration operate economically precisely like a monopoly. As such a plan of developing the live-stock industry of a country grows, the more difficult does it become for a *new* creation of the breeder to get a foothold. If it is new, it is by definition not "pure-bred," because if it were "pure-bred" it must belong to one or another of the established breeds. But anything not "pure-bred" has no recognized standing, or market value. Without regard to the merits of the individual the mere fact of pedigree registration adds a definite and not inconsiderable amount to the monetary value of an animal. In last analysis this fact is to-day one of the strongest arguments which can be made to the farmer in favor of keeping "pure-bred" animals.

[6] *American Naturalist*, 1912.

What has just been said is not intended in any way to criticise, or belittle the importance and value of the "pure-bred" registry system of developing the live-stock industry of the world. I merely wish to point out that when he adopted the system, the animal breeder took upon himself along with the advantages certain very real restrictions to the freedom of his breeding operations, which the plant breeder has escaped. The animal-breeding industry of the world has developed as a system of pedigreed aristocracy. The plant-breeding industry is developing as a democracy. The "social position" of a horse or a cow is primarily determined on the basis of whether it had a grandfather or not. A variety of oats takes its place in the world by virtue of its own inherent qualities, with no questions asked about forebears or the orthodoxy of their marital relations. Both aristocracies and democracies have their advantages and their disadvantages as social systems. These merits and defects are just as real and effective in their operation whether the ultimate vital unit of the system be a man, a cow or an oat plant.

Owing to the essentially different conditions and methods of work which obtain in plant breeding, this field is able to reap more direct benefits of a practical character from the advances which have been made in the science of genetics, than is animal breeding. In the creation of new races by hybridization the plant breeder can and does take Mendelian principles as a direct and immediate guide. He has made Mendelism a working tool of his craft.

To conclude: What I have tried to do in this paper is to discuss the relation between the science of genetics and the practical art of breeding as they actually have developed and now exist. Your attention has been directed to the obvious fact that animal breeding has, without the aid of genetic science, attained an extremely high level of achievement. Empirical methods can only have been successful when they were fundamentally in accord with natural laws, and it is therefore not to be considered surprising that the recent discoveries of world-old genetic laws have not radically modified the successful animal breeders' methods. In pointing out that a scientifically trained geneticist is not as yet an absolutely indispensable necessity on a successful animal breeding farm I have no thought or desire to belittle the importance of the science of genetics. My zeal and enthusiasm for the advance of knowledge in this field know no bounds. This attitude, however, furnishes no reason that the geneticist should delude himself, or by rash statements hold out false hopes to the breeder, as to the immediate practical importance of some of the recent developments in the science of genetics. All knowledge is potentially useful, but the fundamental reason for undertaking and encouraging research in genetics, or anything else, is not because what one gets may be useful, but because it is *knowledge.*

Raymond Pearl
Maine Agricultural Experiment Station

THE METAMORPHOSIS OF THE CARNEGIE FOUNDATION

That part—a relatively small part—of the new annual report of the Carnegie Foundation which deals with the affairs of the foundation itself, is significant chiefly as showing that the president of the foundation, at least, has already abandoned most of those principles which at the outset were generally understood to govern the foundation's policy with respect to retiring allowances. It is worth while to recall what some of those principles were.

1. The primary purpose of the pension system was to be, not to relieve deserving and necessitous college teachers in their old age, but to better the profession as a whole, "to attract into it increasing numbers of strong

men"[1] and to increase its "social dignity and stability," by increasing the eventual reward of those who continue long in it and reach professorial rank in institutions of sound educational standards. This was laid down as one of the "two fundamental principles" in the first annual report. President Pritchett therein wrote:

> In the long run, men's personal preference for the work of the teacher . . . can not be depended on to secure an adequate supply of the best men. This fact the older European countries long ago recognized, and in order to secure for the place of teacher the best men, they have sought to dignify the profession of the teacher by the highest social and official honors; and they have sought in addition to strengthen it by larger financial rewards. And inasmuch as the salaries of the teachers can not be made equal to those of outside professions this reward has come, in the main, by the establishment of a system of pensions. . . . In other words, the first and largest ground for the establishment of systems of retiring pensions for teachers has been found in a wish to strengthen the teaching profession.[2]

2. As a necessary consequence of the preceding, a second principle repeatedly enunciated in the earlier reports was that the retiring allowance "should come as a matter of right, not as a charity." President Pritchett wrote in 1906:

> No ambitious and independent professor wishes to find himself in the position of accepting a charity or a favor, and the retiring allowance system simply as a charity has little to commend it. It would unquestionably relieve here and there distress of a most pathetic sort, but, like all other ill-considered charity, it would work harm in other directions. It is essential, in the opinion of the trustees, that the fund shall be so administered as to appeal to the professors in American and Canadian colleges from the standpoint of a right, not from that of charity, to the end that the teacher shall receive his retiring allowance on exactly the same basis as that upon which he receives his active salary, as a part of his academic compensation.

3. One of the purposes especially emphasized in the first report was that of "freshening the work of the colleges themselves by enabling them to put new men into the places of those whom old age or disability has rendered unfit for service."[3]

4. Pensions were to be granted on three grounds, old age, length of service and disability. Sixty-five years was specified as the limit of age and twenty-five years in professorial grades "as the limit of service upon which a pension may be earned." Widows of professors were to receive one half the allowances to which their husbands would have been entitled.

Upon these points the opinions of President Pritchett have by this time singularly changed. It will be convenient, in noting these changes, to take up the points in reverse order.

4. (*a*) The service-pension provisions of the foundation were, as is generally known, abolished without warning in 1909; that is an old story, little creditable to the executive authorities of the foundation, to which it would not now be needful to recur, did not President Pritchett repeat certain aspersions (already made in the fourth report) upon the members of the profession who became entitled to, and accepted, those pensions prior to 1910; and did he not misrepresent the original policy of the foundation in this matter. Dr. Pritchett now writes:

> The service-pension rule was adopted by the trustees under the assumption that but few applications would be made under it, and that these would be in the main applications from men who were disabled for further service. The intention was, in fact, to use the rule as a disability provision. The outcome showed what might have been clearly foreseen at the beginning, that college presidents and college teachers can no more rise above the ordinary appeal of self-interest than other educated and intelligent men. . . . It has been discouraging at times to find men in the early fifties, in the prime of health and strength, applying for pensions upon trivial and selfish grounds in order to escape from teaching.[4]

[1] First report, p. 37.
[2] *Ibid.*, p. 31.
[3] *Ibid.*, p. 7.
[4] Seventh report, pp. 82–84.

This passage is at once a misleading account of the original service-pension policy of the foundation, and a peculiarly discreditable act of injustice to the seventy gentlemen who received service pensions (in "accepted institutions") under the former rules. It is to be supposed that if the trustees had in 1906 the intentions now retrospectively ascribed to them, they had sufficient access to dictionaries of the English language to be able to give some expression to those intentions. But in fact, they gave no hint then, or in the following years, that they meant the service-pension to be subject to any other limitations than those clearly specified in the rules; and they plainly indicated they did *not* regard it as a disability pension, since, in the annual records of retiring allowances granted, three classes have from the first been distinguished—those granted "on basis of age," "on basis of service," and "on basis of disability." What the foundation did was to declare that a certain number of years constituted "the limit of service upon which a pension may be earned," the pension coming then "upon exactly the same basis as" the recipient's "active salary." Having offered pensions to a number of men on these definitely specified terms, President Pritchett now publishes reflections upon them for accepting the pensions upon those terms. It can not even be said (what Dr. Pritchett implies) that the recipients of service pensions had reason to know that they were taking "for their greater comfort pensions that would mean great relief to more needy teachers." For the first report gave assurance that the income was sufficient to provide for all professors in many more institutions than were on the accepted list; and that it was even hoped that after trial "a more generous scale of pensions" than that then in force could be adopted, "either by extending [*sic*] the limit of age or of service, or by increasing the amount of the individual pension."[5]

(*b*) It now becomes evident that, if the future policy of the trustees is to be guided by the views of the president, the old-age pension also is destined to great modification, and probably to abolition. Dr. Pritchett now writes on this as follows:

> The experience of the foundation shows that the minimum age limit should be set higher than sixty-five. . . . Just what age is the best to set as a minimum limit it is difficult to say. The whole matter comes back to *a conception of the pension which is somewhat different from that which we all very naturally entertained at the beginning, that is, that the pension is not intended to assist the man of strong body and mind to get out of teaching at any assigned age, it is to take care of him when his powers fail and he can no longer do his work well.* To raise the limit of age works no hardship to the man who is broken in health at sixty-five. Such a man would be retired on the ground of disability. One places a different ideal before the teacher, moreover, when he suggests *retirement on the ground of approaching weakness rather than on the ground of a definite limit of* age.[6]

Thus the entire system of professorial pensions may be expected soon to be based upon only one—and that the last—of the three grounds originally recognized, viz., disability.

3. There naturally goes with this change an abandonment of the purpose of "freshening" the teaching in the colleges by facilitating the retirement (under the age limit) of men not physically disabled but of impaired efficiency.

> The anticipation of college presidents that inefficient men could be disposed of by a pension has proven another delusion.[7]

2. As the foregoing suggests, Dr. Pritchett has already very nearly come to look upon the foundation over which he presides as essentially eleemosynary in its purpose. With some indirection, yet unmistakably enough, he intimates that, in his opinion, teachers possessing "an adequate or modest income" can not with entire propriety accept pensions. He finds that the teacher does *not* "receive his retiring allowance on exactly the same basis as that

[5] First report, p. 15.

[6] Seventh report, p. 69; italics mine. It should be added that President Pritchett regards the plan of contributory pensions as the ideal one, though he does not definitely urge its adoption by the foundation.

[7] Seventh report, p. 84.

upon which he receives his active salary." President Pritchett is, indeed, not quite able to forget his early insistence upon the principle that the foundation's pensions "come as a right, not as a charity." He therefore repeats this, and straightway unsays it.

While the trustees have sought, and rightly sought, to have teachers in the accepted institutions feel that the pension is a thing earned and not a charity, nevertheless it ought to be said that the acceptance of it does not stand upon quite the same basis as the acceptance of a salary, nor have teachers appreciated quite fully that their own attitude towards this gift and its use would have its effect upon educational giving and the estimation that the world puts upon the motives and ideals of teachers. The foundation would not in any respect diminish the feeling that the teacher, in an accepted institution, may accept the pension as a right, not as a favor. None the less it remains true that this is a free gift, and that the well-to-do man who accepts it thereby makes it impossible to extend the help of a pension to one who really needs it.[8]

A Carnegie pension, therefore, is hereafter to be regarded as a "right" which is at the same time "a free gift"; it is a thing earned which yet one ought not to accept if one already has a competency—a paradoxical entity indeed. President Pritchett does not thus far indicate that the trustees, before awarding pensions, mean to use the methods of the charity organization society in order to establish the fact of the applicant's poverty; though the past history of the foundation justifies no confidence that the rules will not in time be changed so as to provide for something of this sort. Nor, if poverty is really presupposed, ought the manner of establishment of the fact to be left undetermined. But for the present the question is left "for the individual himself to settle." The individual, however, receives a plain hint that he is expected to settle it only in one way. Thus the basis upon which pensions may, in President Pritchett's view, hereafter legitimately be applied for is not service rendered, but destitution. He would have them go exclusively to aged professors who are also disabled and who "really need" such a "free gift" for their support, and to widows similarly in need.

1. All this means, of course, that the purpose which the early statements of the foundation gave as its chief reason for being has now been discarded altogether. This follows both from the particular nature of the changes already made or foreshadowed, and also from the fact, now abundantly evident, that, in general, constant change in its purposes and its rules is the most distinguishing feature of the foundation's conduct. The reward to be expected by the reasonably successful and thrifty member of the teaching profession will be in no degree increased, if the system is put upon the basis which President Pritchett now recommends. The "social dignity" of the profession will be in no way enhanced by the maintenance of a fund for the relief of destitute and disabled professors and their relicts, least of all, if it is to continue to be a feature of the foundation's policy to publish periodic animadversions upon persons who have accepted pensions to which the plain language of the rules seemed to entitle them, and if the annual reports are regularly to contain melancholy reflections on "the darker side of pension administration" and the surprising "selfishness" of many teachers. "Increasing numbers of strong men" are little likely to be attracted into the profession in their twenties by the expectation of receiving a "free gift" at nearly seventy, on condition that they are then incapacitated and without means of support—especially when they know that the corporation promising this gift reserves and frequently exercises the right to disappoint the expectations which it has aroused.

While the new report thus manifests a reversal of the principles originally adopted on these four essential points, it records one change which is more in keeping with those principles than has been the practise heretofore prevailing. Hereafter no new grants are to be made to persons not in "accepted institutions."

Though the relation of cause and effect is not altogether plainly avowed, the probable

[8] *Ibid.*, p. 83.

reason for all five of these changes of heart is to be sought in the foundation's financial situation. The actuarial calculations upon which the trustees based their original plans have proved far too sanguine. The first report estimated that the average pension under the rules then in force would be less than $1,450. The present general average is $1,677; of those in accepted institutions, about $1,780. If it were not for the obligations assumed towards persons not in accepted institutions, even with this increase the pensions paid to the present number of professors or widows of professors in such institutions would leave a surplus out of the annual income of about $200,000; as it is, there is an accumulation in the past year of some $42,000. The present close approach of the foundation's expenditure to its income is thus chiefly due to the policy of making special grants, hereafter to be abandoned. But even with this charge in process of elimination, the time when claims for pensions, valid under the present rules, will far exceed income is clearly in sight. It was expected in 1906 that an income of $500,000 would maintain an adequate pension system for between 100 and 120 colleges—as many as were thought likely to come upon the accepted list. At present the providing of pensions—with the service-pension abolished—for 72 institutions only, requires an expenditure of $478,440; and it is estimated that "at the end of a generation," if the existing rules should remain unchanged, the claims to pensions *coming from these institutions alone—assuming their faculties to remain stationary in number and the average age of retirement to be sixty-nine*—would call for annual payments of $1,375,000. The foundation's total income, "when the whole of the gifts already made to it by the founder are paid in, will amount to approximately $800,000."[9] Consequently, if the endowment is not increased, the rules for the granting of pensions will inevitably have to be so modified as to reduce greatly the average amount allowed, or the number of valid claims, or both.

In so far, then, as the changes of policy now suggested are designed to meet this future contingency, they may claim the justification of necessity. In attempting to provide pensions, upon the excellent principles originally proposed, for so large a number of institutions, the foundation was attempting a thing impossible with the funds at its disposal. That its impossibility was not foreseen at the outset by the officials of the foundation is amazing. It is true, as President Pritchett constantly remarks, that no complete data bearing upon exactly the foundation's problem were available in 1906. But most of the recently gathered facts with regard to the number, rate of increase of number and of salaries, and age-distribution, of teachers in accepted institutions, upon which facts the present calculations are based, could equally well have been obtained six years earlier; and their indispensableness was then equally obvious. The report of Messrs. Pritchett and Vanderlip[10] upon which the original estimates appear to have been largely based, actually contained no reference to the all-important factor of age-distribution in the case of men not yet of pensionable age. It implied, for example. that the number of professors over 65 in 1905 would approximately indicate the number of the same class in subsequent years. It would be hard to imagine an actuarial error more glaring or more easily avoidable. This error, and the insufficiency of the foundation's endowment for its announced intentions, were clearly pointed out by Professor Cattell in Science four years ago.

If, then, the foundation (or its president) has within six years abandoned most of its original ideals, and if the university teachers of America have generally lost confidence in the stability of the foundation's policy and the trustworthiness of its promises, this disappointing outcome is the natural consequence of the initial adoption of a program manifestly impossible with the available endowment. The mistake in that program did not consist in its essential principles; it consisted in making the rules completely retroactive; in authorizing special grants; and above all in

[9] *Ibid.*, p. 92.

[10] First report, pp. 10–16.

attempting to provide for too many colleges. President Pritchett in his first report justly remarked:

> No one can doubt that the establishment of an effective system of retiring allowances in one hundred institutions will contribute vastly more to the introduction of the retiring-pay principle in American education than the maintenance of a charitable fund for a much larger number of institutions.

But the "one hundred" in this sentence was itself far too large a number. The final result, now definitely foreshadowed, of this original over-estimate seems likely to be that the foundation will in time be nothing more or less than a charitable fund for from seventy-five to one hundred institutions.

A charitable fund, no doubt, will have its uses; it will mean relief from anxiety and distress for a considerable number of worthy and unfortunate people connected with our colleges. But it will render none of those services to "the advancement of teaching" which were once understood to be the chief function of the foundation.

It is, however, possibly even now not too late for a return to first principles—though it, like any other course of action now open to the foundation, would probably involve some hardship. Let the foundation add no more colleges to its "accepted list"; let it, if actuarial analysis should show this to be feasible, announce that all professors who now have legitimate expectations of pensions under the present rules will have those expectations duly realized; or if, as is probable, this is financially impossible, let it provide that at least all now over forty-five or fifty years of age will have their claims met as they mature. But for all others let the present rules be temporarily abrogated. Let the foundation then select carefully a much smaller number of colleges, on the basis of educational standards, geographical situation, and certain other considerations. Let it then, after thorough actuarial study, establish for these institutions a stable system of retiring allowances, *upon the general principles which the foundation first laid down,* with the further requirement that the institution shall contribute a part of each pension, and without requiring absolute cessation of academic activity. These things done, the great initial error would be largely corrected, and the foundation's original purposes would be realized in the measure which its endowment permits.[11] Such a plan would indeed do more not only to establish the "retiring-pay principle," but also to increase the attractiveness, the dignity and the efficiency of the college-teaching profession, than would "the maintenance of a charitable fund for a much larger number of institutions."

It may be, however, that a still more thorough statistical analysis than has yet been made would show that the resources of the foundation will not support such a system for more than an extremely small number of colleges. If this should prove to be the case, there might be defensible grounds for a decision to maintain thereafter, for a larger number, disability-pensions only. But if the foundation should be reduced to this necessity, pensions should be granted for disability (to persons genuinely committed to the teaching profession) at any period of life, or to professors' widows, whatever the age of the husband at the time of death. A disability-pension system is likely to serve the most urgent need precisely in case of break-down or sudden death in middle life, while the family suffering such misfortune still has young children to be educated and before the accumulation of considerable savings has been possible. Furthermore, whatever pensions are provided for should be granted to legitimate applicants without special presumption of poverty. Such a plan, in my opinion, should be the last resort of the foundation; and if adopted it should be frankly recognized as what it is. Yet even it would be preferable to a scheme of the equivocal sort which the president of the foundation now appears to regard with favor.

[11] Another possible solution which merits consideration would be to use the income to aid institutions to establish pension systems. The reasons given (p. 79) for the original rejection of this plan do not seem conclusive.

But the most needful change in the pension policy of the foundation is a cessation of change. The worst possible trait in any system of annuities or insurance is the trait which has hitherto conspicuously characterized the administration of those who have had Mr. Carnegie's great gift in their charge—untrustworthiness. Whatever else it is, a pension system should be a thing which can be depended upon, to which men can adjust their plans with confidence. All its dealings should be marked by an *uberrima fides*. Its rules should be definite and comprehensive; and they should not subsequently have read into them meanings contrary to their natural sense. It is imperative, therefore, that the foundation take the necessary measures to ensure the stability of its policy. It should first of all determine with the utmost care and thoroughness what it is financially able to do. It should thereafter confine its promises within the limits of its possibilities. It should then keep the promises it makes.

Arthur O. Lovejoy

GEORGE HAROLD DREW

George Harold Drew, B.A., of Cambridge, one of the most brilliant of the younger biologists of England, died suddenly on January 30, 1913.

He was the only son of George Samuel Drew, Esq., of Paignton, Devon; and was born on October 23, 1881, and educated at New College, Eastbourne.

He was entrance exhibitioner at Cambridge in 1900 and was elected in June, 1901, to a scholarship in the university, where he paid special attention to the natural sciences and to the more scientific aspects of the medical courses. In 1906 he obtained a scholarship in St. Mary's Hospital, and in 1908 he studied in the Marine Biological Station at Plymouth and was also lecturer in biology in the Plymouth Technical School. In 1910 he was appointed Beit memorial fellow in medical research for the zoological department of cancer, and in 1912 he was elected to the John Lucas Walker studentship for pathology in the University of Cambridge, and on January 1, 1913, he was appointed research associate in the department of marine zoology of the Carnegie Institution of Washington.

He was distinguished not only for his remarkable breadth of knowledge, but even more so for a rare aptitude and insight into methods of research which, had his life been spared, would have led to his name being known among the very few of England's great men of science; but in the springtime of his high promise he passed away and the all but unheeding world has lost a great leader who was to be.

He was the author of only fifteen papers, yet among them are some notable contributions to science.

In coral reef regions naturalists have long been familiar with the vast areas covered with finely divided limestone which has commonly been called "coral mud." In 1910, however, Vaughan stated that these limestone muds appeared to be of chemical origin, and in 1911 Drew discovered that there is in the warm surface waters of the tropical Atlantic a bacillus which is exceedingly abundant and which denitrifies the sea water, thus enabling the dissolved carbon dioxide to combine with the calcium and to form a precipitate of calcium carbonate.

Thus the vast beds of limestone which in coral reef regions are often hundreds of feet in thickness and thousands of square miles in area are formed mainly through the activity of Drew's bacillus.

Moreover, the presence of this denitrifying bacillus in tropical seas accounts for the paucity of sea-weeds in the warm oceans, and the blue color of "coral seas" may in some measure at least be due to the presence of the finely divided particles of calcium carbonate suspended in the water.

Recent studies by Vaughan appear to indicate that oolite is ultimately formed from this precipitated calcium by attraction of the particles to the films of gas bubbles, or to solid nuclei, in the manner described by Linch.

Drew's interest, however, extended to subjects other than those of oceanography; for

his remarkable work in the production of ciliated cysts, and other abnormal growths due to artificial stimulation in *Pecten* and other marine invertebrates led to his being appointed to the Beit fellowship for the study of cancer.

He was, however, far more than a young man whose ability, training and energy inspired confidence respecting his ultimate high position in attainment, for he was an English gentleman, simple in manner, generous in spirit; a charming, brilliant companion, a warm-hearted friend, and above all one whose aim it was to give to the world all that lay within his power to bestow as a servant of the high ideals of civilization.

ALFRED G. MAYER

FUR SEAL LEGISLATION

THE following letter has been addressed to members of congress under date of March 31, 1913:

The fur seal legislation of the 62d Congress has been left in very unsatisfactory shape. A treaty was entered into on July 7, 1911, by the United States, Great Britain, Japan and Russia, for the suspension of pelagic sealing for fifteen years. This treaty provides protection for the mother seal on her migration and feeding journeys and guarantees the future prosperity of the herd. The treaty was promptly ratified by the Senate, but in the act of August 24, 1912, designed to give effect to this treaty, was included an amendment suspending land sealing—the killing of the superfluous males—for five years. The significant relation of this amendment to the treaty is that the United States agreed to share its land catch with Great Britain and Japan in return for the abandonment by their citizens of the pelagic industry. We are as firmly bound to continue land sealing and share its product as are Great Britain and Japan to prohibit pelagic sealing. Dissatisfaction naturally results from our action. Abrogation of the treaty would be followed by resumption of pelagic sealing, with ultimate destruction of the herd. Even if the treaty be not openly broken, our indifference to our obligations warrants like indifference on the part of our neighbors in enforcing prohibition, leading to illicit open sea sealing.

The final act of the 62d Congress is not less inimical to the welfare of the herd. This was to cut from the Sundry Civil Bill the appropriation for the maintenance of the government force of agents on the fur seal islands, reducing this force to a single care-taker for each island. This is in effect a notice that we have weakened the land defenses of the herd. It is an invitation to the lawless element, largely present among the pelagic sealers, to raid the islands and attack the herd upon its breeding haunts. The natives on the islands are effective defenders only under intelligent and courageous direction. One man can not guard twenty-five miles of shore, for the most part difficult of access through absence of roads and means of transportation. It will not be forgotten that in 1906 Japanese sealers landed upon the rookeries in spite of the active revenue patrol, and were only prevented from inflicting heavy damage upon the herd by the prompt and courageous defense of the resident agents and the natives, a dozen or more of the raiders being killed before the attacks were finally warded off. Reduced to a single care-taker on each island—they are forty miles apart—the island force can make no adequate defense.

The property interests thus being trifled with are of great value, capable of yielding a land catch in 1913 worth not less than $400,000, and this income will grow steadily. To maintain the herd requires protection for its breeding stock on the high seas and upon the breeding grounds. The treaty of July 7, 1911, guarantees the first, the island guards, the second. It is the duty of the 63d Congress to repeal the provision of the law of August 24, 1912, suspending land sealing, and to restore to the appropriation bills the sum necessary to maintain intact the force for island defense.

Respectfully submitted,

DAVID STARR JORDAN, *Commissioner in Charge of Investigations, 1896–7.*
GEORGE ARCHIBALD CLARK, *Secretary of Commission, 1896–7, Special Investigator 1909 and 1912.*

THE EUGENICS RECORD OFFICE

THE Eugenics Record Office, which was established at Cold Spring Harbor, Long Island, in October, 1910, by Mrs. E. H. Harriman and which has ever since been active in this field, with the additional assistance of Mr.

John D. Rockefeller and others, has recently entered upon a new stage of its development. A board of scientific directors has been organized, comprising Dr. Alexander Graham Bell, chairman; Dr. William H. Welch, professor of pathology, Johns Hopkins University, vice-chairman; Professor Irving Fisher, Yale University; Professor Lewellys F. Barker, of the Johns Hopkins University; Professor E. E. Southard, of Harvard University and director of the Psychopathic Hospital, Boston, and Dr. C. B. Davenport, secretary of the board and resident director. The board met at Cold Spring Harbor on March 21, and organized its work. The aim of the Eugenics Record Office was defined to be as follows. First, to promote researches in eugenics that shall be of utility to the human race. This part of the program includes: the study of America's most effective blood lines; and the methods of securing the preponderance and relative increase of the best strains; the study of the origin of and the best methods of restricting the strains that produce the defective and delinquent classes of the community; the study of the method of inheritance of particular traits; the study of the consequences of the marriages of close kin; the study of miscegenation in the United States; the study, both in this country and abroad, of the family histories of permanent immigrants. Second, to publish the results of these researches. Third, to provide a fireproof building for the preservation of eugenical records, including genealogical works and town-histories. Fourth, to provide an administrative office and staff to carry out the work. The fireproof building that is to form the new home of the office is being rapidly pushed to completion.

The board of scientific directors of the Eugenics Record Office will meet each spring at Cold Spring Harbor to consider the projects most worthy of support during the ensuing year, which begins October first, and it will meet again in November to receive a report of the work of the office in the preceding fiscal year. The resident director has general charge of the plant and its operations and is authorized to ask for and receive, in the name of the board, funds to carry on the work of the office. The board voted in favor of the organization of a Eugenics Research Association, of which a meeting will be called early in June.

THE NATIONAL ACADEMY OF SCIENCES

The National Academy of Sciences will celebrate the fiftieth anniversary of its foundation at the Smithsonian Institution in Washington April 22–24 inclusive. Following is the preliminary program:

Tuesday, April 22

9:30 A.M. Business meeting of the Academy in National Museum.

11:00 A.M. Opening Session, National Museum.
Welcome by the President of the Academy.
Addresses:
"The Relation of Science to Higher Education in America," President Arthur T. Hadley of Yale.
"International Cooperation in Research," Dr. Arthur Schuster, Secretary of the Royal Society of London.

3:00 P.M. Address:
"The Earth and Sun as Magnets," Dr. George E. Hale, Director of the Mount Wilson Solar Observatory.

9:00 P.M. Reception by the Secretary and Regents of the Smithsonian Institution to the Members of the Academy and their Guests at the National Museum.

Wednesday, April 23

10:30 A.M. Morning Session.
Addresses:
"On the Material Basis of Heredity," Dr. Theodor Boveri, University of Würzburg.
"The Structure of the Universe," Dr. J. C. Kapteyn, Director of the Astronomical Laboratory, University of Groningen.

3:30 P.M. Reception at the White House and Presentation of Medals by the President of the United States.

9:00 P.M. Reception by the Trustees of the Carnegie Institution of Washington to the Members of the Academy and Guests.

Thursday, April 24

9:00 A.M. Meeting of the Council at the National Museum.

9:30 A.M. Business meeting of the Academy at the National Museum.

10:00 A.M. During the business meeting of the Academy, opportunity will be given to guests to visit the scientific bureaus and laboratories of Washington. Automobiles will be provided.

2:00 P.M. Excursion to the Home of Washington at Mount Vernon by the U. S. Despatch Boat *Dolphin* (by courtesy of the Secretary of the Navy).

8:00 P.M. Dinner at the New Willard Hotel.

SCIENTIFIC NOTES AND NEWS

THE Bruce medal of the Astronomical Society of the Pacific has been awarded to Professor J. C. Kapteyn, of Groningen, for his work on the proper motions of the stars.

IT is reported that Professor Czerny, of Heidelberg, will give up next year the direction of the institute for cancer research, which was founded by him.

DEAN RUSSELL H. CHITTENDEN, of the Sheffield Scientific School at Yale, is recovering from the effects of a recent operation, but he will be unable to resume his duties for the remainder of the academic year.

BY action of the board of regents of the University of Michigan, the name of the Museum of Natural History has been changed to the Museum of Zoology, and Professor Alexander G. Ruthven has been promoted from the position of head curator to that of director.

DR. ELIZABETH REBECCA LAIRD, Ph.D. (Bryn Mawr, '01), professor of physics at Mount Holyoke College, has been awarded the Sarah Berliner Research Fellowship.

THE Yale corporation has voted to appoint Professors Pirsson, Barrell, Lull, Irving and Schuchert as the university's representatives to the twelfth International Geological Congress, to be held in Canada this coming August.

PROFESSORS A. G. CHRISTIE, R. C. Disque and H. J. Torkelson, of the college of engineering of the University of Wisconsin, will accompany the American Society of Mechanical Engineers on their trip to Europe this summer.

PROFESSOR M. M. METCALF, head of the department of zoology, at Oberlin, has been granted leave of absence for the second semester for travel and scientific research in California. His classes are being continued by Assistant Professors Jones and Buddington.

DR. R. M. ANDERSON has been appointed assistant in the department of mammalogy of the American Museum of Natural History. Dr. Anderson will accompany the Stefánsson expedition to the Arctic as zoologist and second in command.

THE little power schooner *Polar Bear* sailed for Bering Sea, on April 3, with a party who will make a study of animal and bird life in northern waters. In the party are Mr. Dunbar Lockwood, of Boston; Mr. Samuel Mixter, of Boston, representing the Smithsonian Institution; Mr. W. Sprague Brooks, of Milton, Mass., representing the Museum of Comparative Zoology at Harvard, and Dr. Joseph Dixon, of Berkeley, Cal., representing the Museum of Comparative Zoology at the University of California. The cruise will last six months.

ALFRED VIVIAN, professor of agricultural chemistry, Ohio State University, is making a tour of the world, and is now in India. Professor Vivian will deliver a course of lectures on soil fertility at the agricultural school at Allahabad.

SIR WILLIAM OSLER, regius professor of medicine at Oxford University and delegate of the Oxford University Press, will give an illustrated lecture on "The Oxford University Press," at Harvard University, April 29.

THE Weir Mitchell lecture before the College of Physicians of Philadelphia was delivered on Friday evening, April 4, by Dr. H. P. Armsby, director of the Institute of Animal Nutrition of the Pennsylvania State College, on the subject, "Animal Calorimeters and the Study of Nutrition."

ON April 2, Professor W. B. Cannon, of the Harvard Medical School, addressed the Rush Medical Society and the undergraduates of the medical school of the University of Pennsyl-

vania on "Some Recent Studies on the Bodily Effects of Fear and Rage."

Dr. H. C. Miller, professor of physics, Case School of Applied Science, lectured under the auspices of the Ohio State University chapter of the Sigma Xi Society on March 7, on the topic "Photographing and Analyzing of Sound Waves." The lecture was accompanied with illustrations.

Dr. Raymond Pearl, of the Maine Agricultural Experiment Station, gave a series of three lectures on genetics at the Ontario Agricultural College, Guelph, Canada, on March 25 and 26.

Arthur H. Blanchard, professor of highway engineering in Columbia University, on March 31, delivered an illustrated lecture on "Highway Engineering in Europe and America" before the Brooklyn Institute of Arts and Sciences.

Dr. A. C. Eycleshymer, of St. Louis University, lectured on March 30 at the University of Illinois on "Growing Old and Attempts to Prevent It." It was one of a series on public health given by authorities in various branches of medicine.

Professor George Grant MacCurdy, of Yale University, recently completed a lecture tour of two weeks in the middle west, the subject being "Ancient Man, His Environment and His Art." He spoke at the Art Museum, Toledo; at Alma College, Michigan; at the Field Museum of Natural History, Chicago; at the University of Missouri, Columbia, and before the Anthropological Society of Washington; also for the Archeological Institute of America at St. Louis, Kansas City, Topeka, Cedar Rapids and Davenport.

Professor Robert Woodworth Prentiss, who had held the chair of mathematics and astronomy in Rutgers College since 1891, died on April 5 at the age of fifty-six years.

Dr. George McClellan, a Philadelphia surgeon, known for his researches in anatomy, died on March 29, aged sixty-four years.

Dr. Adolf Slaby, professor of electrotechnics in the Berlin Technical School and the University of Berlin, known to the general public for his contributions to wireless telegraphy, has died at the age of sixty-four years.

At a meeting of the executive committee of the New York Zoological Society held on February 24, Mr. Niles presented a report with reference to charges against Dr. Charles H. Townsend contained in a report of a majority of the committee of the house of representatives on the expenditures in the Department of Commerce and Labor. After reading and careful consideration of Mr. Niles's report, the executive committee passed the following resolutions:

Resolved, That after a full examination of the proceedings of the House Committee on Expenditures in the Department of Commerce and Labor, and of the report submitted by the minority of the said committee by which it appears that the said committee has never held a single meeting for the purpose of considering the evidence, and that the report made by the chairman was never submitted to the committee for its consideration, and that in the opinion of the minority the report had never been approved by a majority of the committee, that it is the unanimous opinion of the Executive Committee that the honesty and integrity of Dr. Charles H. Townsend have not been impugned in any way; that the recommendations of said Congressional Committee are in no wise justified by the evidence taken by the committee; that the report of the majority of the committee is drawn without any reference to the facts in regard to Dr. Townsend's connection with the matter, and that the attack upon him is unjustifiable, malicious and untruthful, and further

Resolved, That the Executive Committee of the New York Zoological Society does unanimously approve and endorse the report upon the subject prepared by Mr. Niles and the conclusions contained therein.

Madison Grant, *Chairman*
Samuel Thorne
Wm. Pierson Hamilton
W. W. Niles
Henry Fairfield Osborn
Frank K. Sturgis
Percy R. Pyne
Lispenard Stewart

The announcement of the twenty-sixth session of the Marine Biological Laboratory, Woods Hole, Mass., has been issued. The im-

portance of the work there accomplished can be seen from the list of the staff, which is as follows:

Investigation in Zoology and Embryology: Gary N. Calkins, professor of protozoology, Columbia University; E. G. Conklin, professor of zoology, Princeton University; Gilman A. Drew, assistant director, Marine Biological Laboratory; George Lefevre, professor of zoology, University of Missouri; Frank R. Lillie, professor of embryology, University of Chicago; T. H. Morgan, professor of experimental zoology, Columbia University; E. B. Wilson, professor of zoology, Columbia University.

Instruction in Zoology: Caswell Grave, associate professor of zoology, Johns Hopkins University; George A. Baitsell, dean and professor of biology, Central College; Raymond Binford, professor of biology, Guilford College; J. K. Breitenbecker, fellow in zoology, University of Chicago; E. J. Lund, Bruce fellow in zoology, Johns Hopkins University; T. S. Painter, graduate student of zoology, Yale University.

Instruction in Embryology: Gilman A. Drew, assistant director, Marine Biological Laboratory; Lorande L. Woodruff, assistant professor of biology, Yale University; A. L. Treadwell, professor of biology, Vassar College; Robert A. Budington, associate professor of zoology, Oberlin College.

Physiology: Albert P. Mathews, professor of physiological chemistry, University of Chicago; R. S. Lillie, assistant professor of experimental biology, University of Pennsylvania; Harold C. Bradley, assistant professor of physiological chemistry, University of Wisconsin.

Botany: George T. Moore, Engelmann professor of botany, Washington University; George R. Lyman, assistant professor of botany, Dartmouth College; B. M. Duggar, professor of plant physiology, Washington University; Ivey F. Lewis, assistant professor of botany, University of Wisconsin; W. J. Robbins, assistant in plant physiology, Cornell University; R. H. Colley, instructor in botany, Dartmouth College; A. R. Davis, Lockland research fellow, Shaw School of Botany.

Philosophical Aspects of Biology: Edward G. Spaulding, assistant professor of philosophy, Princeton University.

THE twenty-fourth session of the Biological Laboratory of the Brooklyn Institute of Arts and Sciences located at Cold Spring Harbor, New York, will be held during six weeks, beginning Wednesday, June 25. Investigators may make arrangements for using the laboratory at other times of the year but board at the laboratory will not be guaranteed before June 23 nor after August 9. The instruction offered this year consists of the following courses: field zoology by Professor Herbert E. Walter, of Brown University, Dr. A. H. Melander, professor of entomology at the University of Washington, and Dr. C. B. Davenport. A course in bird study will be given by Mrs. Alice Hall Walter, and by Dr. C. E. Ehinger, of the Pennsylvania State Normal School. Comparative anatomy, by Professor Henry S. Pratt, of Haverford College, and Dr. David D. Whitney, of Wesleyan University. Animal bionomics and evolution by Dr. Davenport. Cryptogamic botany by Dr. Harlan H. York, of Brown University, and Dr. W. E. Maneval, of Randolph-Macon College. Plant geography and ecology, by Professor John W. Harshberger, of the University of Pennsylvania. Those who wish to carry on investigation at the laboratory are invited to correspond with one of the above-named instructors. As in the preceding three years a training course for field workers in eugenics, strictly limited in attendance, is offered by Dr. Davenport and Mr. H. H. Laughlin. The announcement of the laboratory for the coming summer may be obtained by addressing the director, Dr. C. B. Davenport, Cold Spring Harbor, Long Island, N. Y.

A STATION for instruction and research in biology will be maintained by the University of Michigan, for the fifth season, as a part of its regular summer session, during the eight weeks from July 1 to August 22. The station is located near the Bogardus Engineering Camp of the university on a tract of about 1,666 acres of land owned by the university and stretching from Douglas Lake to Burt Lake in Cheboygan County, Michigan, 17 miles south of the Straits of Mackinac. The instructors will include: Henry Allan Gleason, Ph.D., assistant professor of botany in the University of Michigan, acting director of the Biological Station; Frank Smith, A.M., associate professor of zoology in the Univer-

sity of Illinois, assistant professor of zoology; Max Mapes Ellis, Ph.D., instructor in biology in the University of Colorado, instructor in zoology; Harry Nichols Whitford, Ph.D., instructor in botany, and Paul Smith Welch, A.M., fellow in zoology in the University of Illinois, instructor in entomology.

The American Museum of Natural History, New York, has adopted a pension plan which went into effect on March 1. It is said to be the first instance in this country of a museum of sciences originating a pension system for the benefit of its employees. The idea was suggested to President Osborn after an investigation of the pension plans in operation in Europe. The plan is a contributory system, three per cent. of the annual salaries being paid to the fund by the employees and a like amount by the corporation. The plan provides: (1) Pensions—Six classes of pensions according to length of service and age, the pensions varying from twenty-five to fifty per cent. of the average salary of the last three years. (2) Health Insurance—Gratuity to the employee in case he is totally disabled through illness, or his position is abolished. (3) Life Insurance—Gratuity to a beneficiary, in the event of the death of the employee, and under certain conditions in the event of the death of a pensioner. (4) For the return of the employee's contribution with simple interest at three per cent. in case the employee leaves the service of the museum before he is eligible for a pension.

The U. S. Civil Service Commission announces an open competitive examination on May 12 for irrigation managers and assistants to fill vacancies in the position of irrigation manager at salaries ranging from $1,800 to $2,500 a year, and vacancies in the position of assistant manager at salaries ranging from $1,500 to $2,000 a year, in the Reclamation Service, the salaries being dependent upon the size of the project and individual qualifications.

A long summer trip is being planned for advanced geological students in Sheffield Scientific School of Yale University who are ready to complete their field work in geological surveying. For the past two summers, this work has been carried on in the region about Natural Bridge, Virginia; this year the field course, which will cover the six weeks from June 25 to August 6, will be carried on in the Spearfish Quadrangle, near Deadwood, South Dakota, in the heart of the Black Hills.

A cablegram to the New York *Times* states that the Atlantic transport steamship *Minneapolis* is carrying to America a consignment of about 600 British song birds for the great aviary in Michigan owned by Mr. Henry Ford, the automobile manufacturer. The aviary consists of about ten acres of land inclosed and covered with netting and is said to be the largest in the world. The consignment includes 120 larks, 120 linnets, 70 chaffinches, 100 greenfinches, 20 yellowhammers, 12 bullfinches, 40 blackirds and 12 jays.

UNIVERSITY AND EDUCATIONAL NEWS

The legislature of Kansas has appropriated $1,226,000 for the University of Kansas for the next biennium. The legislature refused all requests for new buildings except one for the medical school at Rosedale. The appropriation for maintenance is about $200,000 more than has been granted for any previous biennium for that purpose.

The total appropriations for special purposes of the Ohio State University carried by the appropriation measure now before the legislature, amount to $371,730. Two new buildings are provided for and half of the necessary cost appropriated, the balance to be appropriated next year. These buildings will be for the departments of zoology and botany, and the departments of horticulture and forestry. In addition to the special appropriations, the state levy will provide $400,000 for the general expenses of the university.

An endowment fund of $1,000,000 has been subscribed for Goucher College, Baltimore.

Harvard University has received from the estate of Mrs. Sarah A. Matchett, $150,000 on account of her bequest, to be held as a special

fund to be called the "Matchett Fund," the income of which is to be used for the general purposes of the college.

THE Catholic University, Washington, D. C., is to have three new buildings—two laboratories and a main dining-hall, which will seat 1,000. One building, the chemical laboratory, is to cost $300,000. The second laboratory building will house the departments of physics and mechanical engineering.

GOVERNOR SPRY, of Utah, has approved a bill recently passed by the legislature creating a department of metallurgical research in the state school of mines, the engineering school of the University of Utah. The new department will be in charge of a director who will be given from four to six young mining engineers and metallurgists as assistants. He will have no teaching whatever to do, but will devote his entire time to research work.

VERY radical changes are in progress in the chemical laboratory of the Rensselaer Polytechnic Institute. A new and larger lecture room is being built on top of the present one, and a new "water" laboratory, capable of accommodating sixty students, is under construction on the second floor. This additional laboratory will be very completely equipped for the analysis of water and sewage and every facility will be provided for undertaking such work from the chemical, bacteriological and microscopical standpoints. The quantitative and organic laboratories will be greatly extended, reequipped and furnished with conveniences of recent type, including glass shelving, enlarged hoods and individual arrangements for blast and suction on the desks.

THERE is pending in the Texas legislature a bill providing for the removal of the State Agricultural and Mechanical College from its present location near Bryan to Austin and its merging with the State University.

THE college of education of the Ohio State University will conduct the educational survey of Ohio, which was provided for by a recent act of the legislature. The purpose of this survey is to secure concise information concerning the condition of all educational interests of the state. Upon this information future legislation on educational matters will be based. Dean W. W. Boyd, of the college, will have personal supervision over the survey, which will be started at once.

THE Prussian ministry of education (Kultusministerium) has established a bureau of school information (Kgl. Preuss. Auskunftsstelle für Schulwesen) which was opened on April 1, 1913. Dr. Kullnick has been placed in charge of the bureau and will publish an annual year-book under the title of "Jahrbuch der Königlich Preussischen Auskunftsstelle für Schulwesen." The first issue will appear in November of this year and will include all manner of information concerning school matters, such as is not readily accessible in other official or non-official publications. Each volume will contain at least 320 pages. Persons who are desirous of securing information about German schools or school systems are referred to the new bureau, which will be ready at all times to answer any questions concerning these matters.

THE income of the Theresa Sessel fund given to Yale University for promoting original research in biological studies, will, for the present, be used in establishing two research fellowships, to be awarded on the recommendation of a standing committee composed of the chairman of the departments of physiology, zoology and botany, in consultation with the dean of the graduate school. In making the award, preference will be given to graduates of Yale or other universities, who have already obtained their doctorate and who have demonstrated by their work fitness to carry on successfully original research work of a high order. The fellowships will be of the value of $1,000.

FREDERICK SHELDON traveling fellowships for 1913–14 have been awarded in the sciences at Harvard University as follows:

Donald Clinton Barton, for research in geology in Europe and Egypt during the summer of 1913.

Sidney Fay Blake, for research in botany in Europe.

Elmer Keiser Bolton, for research in chemistry at Berlin.

Richard Maurice Elliott, for research in psychology, particularly in the psychophysics of handwriting, at Berlin and in the various psychological laboratories of Germany.

Harvey Cornelius Hayes, for travel in the United States, between September and February, for the purpose of observing the manufacture of alloys.

Sidney Isaac Kornhauser, for research in zoology at Würzburg and at the Naples Zoological Station.

Edward Hale Perry, for travel in the mining districts of the United States during the summer of 1913.

Joseph Slepian, for research in mathematics in Europe.

Paul Dudley White, for research in pharmacology at London and Strasburg.

Professor Ernest J. Berg, of the department of electrical engineering of the University of Illinois since 1909, has resigned that position to return to a similar position at his alma mater, Union University, at Schenectady, N. Y., and also to become consulting engineer of the General Electric Company of that city.

Professor R. W. Thatcher, director of the Washington Agricultural Experiment Station and head of the department of agriculture of Washington State College, has been elected professor of agricultural chemistry and soils in the University of Minnesota, the appointment becoming effective on May 1.

DISCUSSION AND CORRESPONDENCE

ELECTROMAGNETIC INDUCTION AND RELATIVITY

To the Editor of Science: In the last number of Science (March 14) Professor A. L. Kimball expresses the opinion that my recent experiments on electromagnetic induction are "not so definitely in contradiction to the principle of relativity as may appear at first sight," basing his conclusion on the fact that in certain cases the indication of a measuring instrument depends upon the manner in which it is connected to the apparatus under test.

This is a very important point, but it is naturally one which I had not failed to consider with great care. That no fallacy was made in reaching my conclusion will be evident, I think, from what follows.

Case I.—In my own recent experiments the cylindrical condenser, with its armatures A and B connected together by a wire C, remained at rest while the agent producing the magnetic field, whose direction was parallel to the common axis of the two cylinders, was rotated. The short-circuit by the wire C was then interrupted, *leaving the inner conductor B completely insulated. After the rotation was stopped and the field annulled,* B was tested for charge by connection to an electrometer. *No charge was detected.*

Case II.—Now imagine the condenser, together with its short-circuiting wire C, to rotate while the agent producing the magnetic field remains fixed to the earth. If the wire C is now interrupted, *leaving B completely insulated from A,* and if the condenser is then brought to rest and the field annulled, the cylinder B, *tested exactly as in Case I., will be found charged.* While the experiment in this form has not been made, the result given is an *immediate and necessary consequence* of the experiments by Faraday and others referred to in my earlier article. For no one will contend that in this case the seat of the motional electromotive force is elsewhere than in the wire C and in the dielectric, if any, entrained by the conductors in their motion. Moreover, that the ether is not entrained, and that the entrainement of any air would produce no appreciable effect, are facts which follow from some of the experiments (those on insulators) already referred to. In addition to these considerations only one assumption is necessary to the argument, viz., the assumption that an electric charge of one sign on an insulated conductor is not altered by being brought to rest from a state of motion.

Thus the condenser is actually charged in one case and not charged in the other, the relative motion in the two cases being exactly the same. If complete relativity existed, the condenser, tested in the way described, would be

found to have the same charge in the two cases.

In connection with Professor Kimball's remarks it is of interest to consider also the behavior of two electrometers E and E', one of them, E, fixed within the condenser with its terminals rigidly connected to the armatures A and B, and the other, E', fixed to the magnet, with terminals sliding on A and B. In Case II. E' indicates a voltage equal to the motional electromotive force in the wire C, and E gives no deflection—*not because the condenser is uncharged, but because the motional electromotive force in the electrometer and its leads just balances the voltage in the electric field produced between A and B by the motional electromotive force in the wire C.* In Case I. E again gives no deflection, *there being now no electric field between the armatures and no charge at all on the armatures;* and E' gives the same deflection as before—but whether for the same reason or not is still an open question. It is apparently because Professor Kimball was considering these ambiguous electrometer indications instead of the actual charges on the cylinders that he was led to his conclusion.

S. J. BARNETT
THE OHIO STATE UNIVERSITY,
March 18, 1913

A LABELING SURFACE FOR LABORATORY GLASSWARE

THE ground-glass circular spot now generally furnished on flasks and beakers made of Jena glass suggested to the writer the desirability of a similar labeling surface for microscopic slides, test tubes and other laboratory glassware. Attempts to use hydrofluoric acid showed that the acid in solution would dissolve the glass but would not etch it. "Diamond Ink" made by Merck and obtained from Eimer and Amend was found to give satisfactory results. "White Acid," obtained from the same firm, produces a less heavily frosted surface, but has been used to dilute the diamond ink when the latter has become unduly thickened. Diamond ink comes in gutta-percha bottles and etches glass immediately upon coming in contact with it. The hydrofluoric acid, which is apparently one of the constituents, is volatile. When a bottle has been opened, the fluid tends to creep out by capillarity along the salts that have been deposited by evaporation. The bottles, in consequence, should be kept sealed with paraffine when not in use.

In using, a small amount only of the creamy diamond ink is poured into a stender dish which has been previously coated with paraffine. A rubber stopper has been found to be the best means of applying the ink. One end is dipped into the ink and then pressed against the glass to be etched. If the right edge of the stopper is first touched to the glass and the pressure shifted from right to left and reversed, the fluid is evenly distributed and a small amount only is necessary for the even-edged circular spot which results. The etching takes place at once. The surface, however, is covered by a thick deposit of deliquescent salts which must be washed off before the ground-glass surface is ready to receive pencil marks. Ordinary glassware is easily marked by the method outlined, but the Jena glass tested is etched with more or less difficulty and has been ground on an emery wheel.

Adhesive paper labels are impracticable for test tubes or flasks that have to be sterilized with steam or that are kept in a moist atmosphere where they are liable to the attacks of moulds. Wax pencils, or better, indelible copying pencils moistened with alcohol are useful for temporary labels, but do not withstand steam sterilizing and are not permanent when much handled. Marking diamonds and certain silicate inks have the disadvantage of leaving a written label that can not be removed. A label written with lead pencil on an etched or ground-glass surface, however, has the advantage of permanency so far as ordinary laboratory handling is concerned. It is as permanent as pencil marks on paper and, like these, can be removed with a rubber eraser. The pencil marks are not affected by water nor by steam, but may be readily removed by scouring soaps. In cleaning test tubes, it has been found convenient to remove

the labels by rubbing the surface in a moistened groove in a cake of sapolio.

A. F. Blakeslee

Carnegie Station for
Experimental Evolution,
Cold Spring Harbor, N. Y.

MOST IS—WHAT?

To the Editor of Science: Since the natural sciences came into their inheritance, about thirty years ago, it has been quite the orthodox thing with the "humanists" to demonstrate the inherent disability of these subjects to impart "culture" by satirically deriding the English of embryonic doctorial dissertations. Judge, therefore, of the shock to my esthetic sensibilities occasioned by this sentence, which stands on page 61 in the issue of Science for January 10: *"most of the brotherhood of teachers of English is in the same state,"* where the adjective-noun most, having the plural form because clearly referring to number and not quantity, is made the subject of a verb in the singular number. This communication appears to have been written by a professor of English and, presumably, a humanist.

F. W. Martin

SCIENTIFIC BOOKS

Methods of Measuring Electrical Resistance. By Edwin F. Northrup, Ph.D. New York, McGraw-Hill Book Company. 1912. Pp. xiii + 389. Price $4.00.

The measurement of electrical resistance is of interest not only to the physicists but to engineers and others engaged in scientific, technical and commercial work. The methods used are described in various technical and scientific papers and in text-books on electrical measurements. But only a few of these are described in any one place, if we except Price's book written about twenty years ago. The author "has selected for presentation all those methods which in his judgment are useful, for commercial tests and measurements, for purposes of instruction in educational institutions and for application in technical and research laboratories." So we have collected in one book a large number of methods covering practically the entire field of electrical resistance measurements.

The first part of the book is of an introductory character and better than any other shows the wide experience and sound judgment of the author in matters pertaining to electrical measurements. Particularly good are his comments on accuracy and method and few there are, of those who make electrical measurements, who could not read with profit the first six pages. Then follows a discussion of errors and estimation of the accuracy obtainable by deflection methods. The way an error in measurement may affect the result desired is clearly shown, but no effort is made to arrive at the probable accuracy by the means of the theory of probabilities.

Deflection methods are taken up first. Various voltmeter methods and voltmeter and ammeter methods are considered very fully. Then follows a discussion of null methods and of these the differential galvanometer methods are considered first. In this connection no mention is made of the Kohlrausch method, which is generally considered to be by far the best and by some to be the only differential galvanometer method suitable for use in the precise comparison of resistances.

In the discussion of the Wheatstone bridge methods the Carey Foster method receives the fullest consideration. Six kinds of measurements are listed for which it is stated that this method "is especially useful." For one of these measurements deflection methods give all that is usually desired. When a higher accuracy is necessary it is easily obtained by the simplest kind of a bridge. Another is of interest only to the manufacturer in the adjustment of resistance coils. The other four can, provided a substitution method is used, be made much better with a simple bridge costing not more than half as much as the Carey Foster bridge.

In the discussion concerning Wheatstone bridges various arrangements of ratio and rheostat coils, including the author's four-coil decade, are considered; the author's special bridge for reading directly the per cent. error

in the adjustment of resistance coils is described; and valuable suggestions given in regard to the selection and use of bridges and auxiliary apparatus.

Methods and apparatus for measuring low resistances and calculation of conductivities are treated fully, as are also the methods and apparatus for measuring high resistance and the insulation resistance of cables. A chapter is devoted to the measurement of resistance-containing electromotive forces, insulation resistance with power on, resistances of batteries and electrolytes. Some of the methods described here were developed by the author.

A description is given of the author's dynamometer method for measuring the resistance of an inductive conductor to alternating current. A non-inductive resistance is adjusted so that the power dissipated in it is equal to the power dissipated in the inductive resistance as shown by the dynamometer. The two resistances being in series carry the same current and therefore have the same resistance.

The methods and apparatus used in locating faults are fully described. Here again some of the methods were developed by the author.

One of the important applications of electrical methods to other physical measurements is that of the measurement of temperature or temperature changes by means of the resistance thermometer. Apparatus intended for use between 0 and 100° C. should be capable of indicating small changes in temperature with certainty to .001° C. This means that changes in the resistance of the thermometer must be measured to better than 3½ parts per million of its total resistance. Therefore, careful attention must be given to the compensation for the various changes in resistance of leads, changes in resistance of contacts, etc. As the resistance thermometer must have a small heat capacity to follow temperature changes quickly and as it has a large temperature coefficient, the power supplied by the test current must be kept very small in comparison with that which might be used in the measurement of ordinary manganin coils of the same resistance. For this reason a sensitive galvanometer is required and care must be taken to correct for the thermo-electromotive forces, practically always large enough to introduce an error of a few thousandths of a degree. In discussing resistance thermometers the author apparently fails to appreciate the importance of some of these matters, for the arrangement which he is inclined to believe "offers more advantages than any other" if used in ordinary calorimetric work should hardly be expected to give satisfactory results. Much difficulty would be experienced in an accurate compensation for the changes in the resistance of the galvanometer windings. Then unless the galvanometer were more sensitive than the one which the author states "is amply sensitive for the purpose" we should hardly expect an accuracy better than that obtainable with a good mercury in glass thermometer. The galvanometer should be at least a hundred and preferably over a thousand times more sensitive.

Under the heading "Instruments Used for Measuring Resistances" the reader will find much in the nature of good advice both to the intending purchaser and user of such apparatus.

In the consideration of deflection instruments and galvanometers attention is called to what constitutes desirable qualities in anmeters, voltmeters, pointer galvanometers and mirror galvanometers. Instruments designed by the author and constructed under his supervision are described. The author's method of comparing galvanometers is given fully, together with a table giving constants of sixteen galvanometers. In this connection no reference is made to the important papers of White and Jaeger.

In an appendix a few mathematical formulas and tables, and physical constants are given.

Practically the entire field of resistance measurements is covered and most of the methods used are well described. However it is assumed that a .01 or even a .1 per cent. is a high accuracy and sufficient for all but very exceptional cases. The book will be welcomed by almost every one who uses resistance appa-

ratus and galvanometers—by the men engaged in commercial testing because of the description of the methods suited to the needs and the good advice given in regard to the selection of apparatus for different kinds of work; by the instructor in our educational institutions because it constitutes a valuable reference book for him and his students; by the specialist because to him the author succeeds in a marked degree in giving the benefit of his wide experience in the design, construction, and use of resistance and electrical measuring apparatus.

Frank Wenner
Bureau of Standards

Metabolic Water: Its Production and Rôle in Vital Phenomena. By S. M. Babcock. Research Bulletin No. 22, The University of Wisconsin Agricultural Experiment Station, March, 1912.

The purpose of the author in this paper of 181 pages is to show that metabolic water is not only produced in considerable quantity from the organic constituents of the foods and tissues of plants and animals by oxidation and hydration, but also that water from such sources exercises a different function from imbibed water, and that in very many cases is essential to the growth and continued life of the organism in question. The studies were conducted with corn plants for the most part. The studies from the zoological standpoint were not so extensive. The animals used were clothes moth (*Tinea pellionella*); bee moth (*Galleria mellonella*); pea weevil (*Bruchus quadri-maculatus*); flour beetle (*Tribolium confusum* and *Ephestia kuehniella*).

The scope of the study is indicated by the following selected headings taken from the table of contents: Sources of metabolic water (respiration, etc.); metabolic water in seeds; germination phenomena; metabolic water in mature plants; composition of plant tissues; development of hydrolytic ferments in seeds; imbibition; reserve nutrients in plants; water content of green and ripe fruits; intramolecular respiration; water produced in animal metabolism; water requirements of animals. The author seems to have shown in a rather convincing manner that metabolic water plays an immensely important rôle in the life of both plants and animals. The paper contains many facts collected together in a form such that they should be interesting to every plant physiologist.

Raymond J. Pool
The University of Nebraska

Fresh Air and How to Use It. By Thomas Spees Carrington, M.D. The National Association for the Study and Prevention of Tuberculosis. 1912.

This little book is timely and well conceived. It finds an enormous audience prepared to welcome it through sanitary precepts from press and platform for many years. Therefore the responsibility of the author is somewhat unique. One could wish that the execution of the work might deserve unqualified praise. Fortunately it should be easy for the author to correct such matters as call for adverse criticism.

We believe that it is better to be true than to be convincing. Our author's introduction needs rewriting, for it is founded on the old conception that the prime danger from "bad air" lies in its chemical composition. His effort to put a known good thing on a scientific basis suggests the abominable method of instruction by which many popular school physiologies have been perverted for the purpose of lambasting narcotic drugs and alcohol.

In spite of a vast amount of research we are still none too well informed as to the essential physiological relations of "pure" air.

But it seems to have been demonstrated that all *morbid sensations* attributable to "foul air" depend wholly upon the effects of combined humidity and heat upon the skin. *Moving* air—a breeze—accelerates heat loss from the body, stimulates the skin in other ways and brings subjective comfort. Now in nature moving air is found most easily in the open or at least in apartments exposed to the open. Sanitary architects—God save the mark—find their task in evolving intricacies of construction whose design it is to obviate

the sanitary evils of construction. We have known of school rooms heated by the "indirect method" in which the winter air containing but a few grains of moisture to the cubic foot is warmed by passing over steam coils and then delivered to the school room, whose windows are closed by edict, its relative humidity so lowered that the moisture must be actually sucked from the skins and mucous membranes of the defenceless children. This air is chemically pure but physiologically like salt to a raw surface.

The little book under consideration is excellent in the orderly presentation of the various phases of the subject and too much praise can not be given for its profuseness of illustration, one hundred and fifty cuts being devoted to this purpose. The average mind derives a clearer idea of architectural design from a simple figure than from pages of labored description. It is to be hoped that in preparing another edition the author will carefully review his text with the purpose of removing all obscurity. Thus, the legend to Fig. 1, p. 22, reads "When the upper window sash is let down and the shade lowered, a larger amount of fresh air may be obtained by inserting a strip of open mesh netting between the shade and the roller." This is perfectly clear when the mechanism is understood, but it requires an undue mental effort to grasp its meaning. The author was happy in his section devoted to the use of clothing and he might profitably have discussed somewhat more in detail the physiological relations of textures—as, for example, the relative properties of silk, linen-mesh and woolen underwear. One of the most valuable chapters of the book is that which exploits the advantages of the house roof to the seeker after fresh air. It is worth enquiring whether it would not be well to devise a mirror situated so as to reflect the scenes of the street to relieve the monotony of "sitting out."

In the section devoted to the clothes-closet, it would have been well had the author insisted that garments, before being stored away, should be hung in the open air, in sunlight if possible, *with the pockets turned inside out.*

Few things are more difficult than to present a "nature study" which shall be scientifically true while forensically convincing to the lay mind. The practical essentials of fresh-air teaching have been excellently presented in this volume, but we are all too much interested in the subject to tolerate the smallest gnat in the ointment. Modern research suggests that the open air calls upon the autonomic systems of the body for somewhat the same kind of response that physical exercise demands of the skeletal nerves and muscles. We know definitely that in the treatment of tuberculosis, for example, exercise may be healing or deadly according to the state of the patient. The truth may very well be that a prescription of "fresh air" is not so simple, but must in scientific therapeutics be analyzed into its physical components of barometric pressure, motion, humidity, temperature, illumination and electric tension and to all these there must be added the one constant excipient—elixir of joy.

HENRY SEWALL

SCIENTIFIC JOURNALS AND ARTICLES

THE March number (volume 19, number 6) of the *Bulletin of the American Mathematical Society* contains the following papers: Report of the nineteenth annual meeting of the society, by F. N. Cole; "The product of two or more groups," by G. A. Miller; "The mathematics of Mahāvīrācārya," by D. E. Smith; "Shorter notices:" Townsend and Goodenough's First Course in Calculus and Essentials of Calculus, by N. J. Lennes; Dziobek's Differential- und Integral-Rechnung and Hack's Wahrscheinlichkeitsrechnung, by G. W. Myers; Brill's Relativitätsprinzip, Föppl's Technische Mechanik, Volume I., and Orlich's Theorie der Wechselströme, by E. B. Wilson; "Notes"; and "New Publications."

THE April number of the *Bulletin* contains: "Some general aspects of modern geometry," by E. J. Wilczynski; "On certain non-linear integral equations," by H. Galajikian; "A theorem on asymptotic series," by V. C. Poor; "On Poincaré's correction to Bruns' theo-

rem," by W. D. MacMillan; "Note on the groups for triple-systems," by L. D. Cummings; review of De Séguier's Théorie des Groupes de Substitutions, by G. A. Miller; review of Wilson's Advanced Calculus, by W. E. Byerly; review of Prasad's Differential and Integral Calculus, by E. B. Wilson; "Shorter notices"; Tannery's Mémoires scientifiques, Volume I., by D. E. Smith; Natorp's Logische Grundlagen der exakten Wissenschaften, Grelling-Enriques' Probleme der Wissenschaft, and Volkmann's Erkenntnistheoretische Grundzüge der Naturwissenschaften, by J. W. Young; Pascal's Repertorium der höheren Mathematik, second edition, by C. H. Sisam; Love's Differential and integral calculus, by Arnold Dresden; "Notes"; and "New Publications."

THE INFLUENCE OF VARIOUS EDUCATIONAL INSTITUTIONS UPON THE DEVELOPMENT OF AGRICULTURAL SCIENCE

Education in the general field of agricultural science is coming to occupy so large a place in primary, secondary and collegiate instruction, that the development of this field is of almost universal interest among educational workers. Both the subject matter and the pedagogical methods of agricultural science are so new as to be practically the creation of the present generation of research students and educators. It was of interest to the writer, therefore, to ascertain, as fairly as circumstances would permit, the sources for the inspiration and conception of the men who are building up this new science. It occurred to me to ascertain at what institutions of learning the men who were shaping the thought in this field secured their scholastic training, both undergraduate and postgraduate. Each of the leading educational institutions of the world is generally recognized as standing for a certain type of instruction or conception of educational methods. It seemed to be of interest to determine to what proportionate extent the ideals of each such institution are influencing the development of agricultural science.

For this purpose, a study was made of the number of degrees (exclusive of honorary degrees) granted by each institution to persons who are, or who have been during the past five years, members of the Society for the Promotion of Agricultural Science. This society does not, of course, include every person who is actively engaged in this field of work. But its membership does include a very large proportion of the leaders of this movement in America, and is probably closely representative of the scholastic training which such leadership has received.

DEGREES GRANTED BY VARIOUS INSTITUTIONS TO MEMBERS OF THE SOCIETY FOR PROMOTION OF AGRICULTURAL SCIENCE

	Bachelors	Masters	Doctors
Michigan Agricultural College.	21	15	2
Cornell	9	9	7
Iowa State College	9	9	0
Harvard	4	4	5
University of Wisconsin	3	3	4
Mass. Agricultural College	9	1	0
University of Missouri	5	2	2
University of Michigan	4	2	3
Miss. Agricultural College	5	3	0
University of Illinois	4	2	1
University of Nebraska	4	3	0
Purdue	5	2	0
Yale	3	2	2
University of Maine	4	1	1
University of Ohio	4	0	1
Rutgers College	3	2	0
Johns Hopkins	1	0	3
Kansas Agricultural College	2	2	0
Colorado Agricultural College	2	2	0
So. Dakota Agricultural College.	3	1	0
University of Washington	2	2	0
European universities	2	0	12

The proportionate distribution of the degrees received by these men among the several institutions does not necessarily indicate the relative esteem in which these institutions are now held by men of agricultural science as schools for training in this field. It is probably a more accurate measure of the opportunities which were available at the time when these men were seeking their scholastic training. Again, the present standards and ideals of these institutions may be quite different, with many of these men now on their facul-

ties, from those which prevailed in the institutions when they were undergraduate or graduate students. But it is believed that the figures given above approximately represent the influence of the several institutions upon the general trend of thought in agricultural science.

Of the 54 other degrees granted to members of this society, not more than three came from any one institution. In these computations no account has been taken of honorary degrees, only those granted for completion of prescribed work having been counted.

It is perhaps of interest to note that the 147 men who have been on the membership roll of this society during the past five years have received 128 bachelor's, 82 master's and 51 doctor's degrees earned by undergraduate and graduate study. While statistics as to the scholastic attainments of workers in other educational fields are not available for comparison, it appears to the writer that the scholastic training and ability of the men who are actively engaged in the promotion of agricultural science is certainly such as to command very high respect.

R. W. THATCHER
STATE COLLEGE OF WASHINGTON,
PULLMAN, WASHINGTON

SPECIAL ARTICLES

THE DISTRIBUTION OF OCCIDENTAL SPIDERS

A PERFECT knowledge of geographic distribution can not be had until we have good collections with good field notes from all important regions and a perfect taxonomy. That time is far distant. Meanwhile we can get some indications from the material at hand. One of the interesting problems concerning the relations between the two continents of the western hemisphere is the part, if any, which the West Indies has played in geographic distribution.

Spiders being carnivorous, and so probably not limited in their distribution by the distribution of special food, and being unable to fly or swim great distances, seem to offer excellent material for such a study. Unfortunately large collections have not been made and the taxonomy is rather chaotic. Omitting a number of genera either because of indefiniteness of information as to distribution or obvious errors in taxonomy, there still remain in Petrunkevitch's catalogue[1] 764 genera of spiders found in the western hemisphere. The distribution of these is analyzed to some extent in the table. While 119 of these genera are recorded as occurring in both South America and the United States, it is probable that there would be more were it not for the tendency to magnify taxonomic differences when political boundaries are crossed. It is somewhat surprising, in view of the usual notion that insular conditions lead to taxonomic separation, to find that only 14 per cent. of the West Indian genera are not found in neighboring regions, while 60 per cent. of the South American do not occur elsewhere. Even 22 per cent. of the Central American (Mexico being included) genera are not recorded as occurring in the adjacent regions.

Distribution of Genera of Spiders. Bold-faced type shows actual numbers; ordinary type, percentages.

	S. A.	C. A.	W. I.	U. S.
Total.....	**565**	**251**	**133**	**240**
Exclusive[2].....	**338** 59.8	**54** 21.5	**18** 13.6	**90** 37.5
S. A., C.A.....	**63** 11.2	**63** 25.1	**18** 13.6	**36** 15.0
S. A., W. I.....	**27** 4.8	**18** 7.2	**27** 20.4	**7** 2.9
S. A., U. S.....	**30** 5.3	**36** 14.3	**7** 5.3	**30** 12.5
C. A., W. I.....	**18** 3.2	**6** 2.4	**6** 4.5	**8** 3.3
C. A., U. S.....	**36** 6.4	**20** 8.0	**8** 6.0	**20** 8.3
W. I., U. S.....	**7** 1.2	**8** 3.2	**3** 2.3	**3** 1.3
All four.....	**46** 8.1	**46** 18.3	**46** 34.6	**46** 19.2

[1] A. Petrunkevitch, "A Synonymic Index-catalogue of Spiders of North, Central and South America with all Adjacent Islands," *Bull. Amer. Museum Nat. History*, Vol. XXIX., 1911.

[2] In the sense that they are not recorded from any of the other regions considered here.

Of the 119 genera common to South America and the United States 39 per cent. are recorded also from both Central America and the West Indies, 30 per cent. also from Central America, 6 per cent. also from the West Indies and 25 per cent. from neither. It is probable that the latter percentage will be greatly reduced by further exploration of the intervening regions and by revisions of taxonomy by which either these genera will be split or species from intervening regions will be united with them. However, such distribution is not unusual in other groups and can not be discussed profitably more in detail with this material. The following extreme illustrations from the Linyphiidæ may be cited. *Gonatium* with one species in Patagonia, two in northern United States (one of them also in Europe) and one in Greenland; *Gongylidiellum* (closely related to *Gonatium*) with two species in Patagonia (one of them also in Argentina) and three species from Maryland to New York; and *Minyriolus* with one species in Patagonia and one in Massachusetts.

It was noted above that only 6 per cent. of the genera common to South America and the United States are found elsewhere in the West Indies, but not in Central America. Leaving out of the question the fact that these may eventually be found in Central America, it is evident that the West Indies have not been an important highway for the interchange of Arachnid fauna. We should expect the influence it has had to be most apparent in the fauna of our southeastern states, but only one out of 62 genera common to that region and South America is found in the West Indies and not recorded from Central America, while 35 per cent. of them are found in Central America and not recorded from the West Indies. This one genus is *Bolostromus* with one species (*B. fluviatilis*) recorded from Alabama, one (*B. insularis*) from St. Vincent and four from South America.

Therefore, making all allowances for deficiencies in taxonomy, records and my analysis of the records, we must conclude that practically the only interchange of spiders between the two continents has been by way of Central America.

Frank E. Lutz

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.
SECTION D

Professor O. P. Hood, mechanical engineer for the Bureau of Mines, was elected vice-president of the association and chairman of Section D for the next meeting, at Atlanta. Professor A. H. Blanchard, of Columbia University, was elected secretary for five years to succeed G. W. Bissell, whose term expired. G. W. Bissell was elected a member of the council for the Atlanta meeting, and Mr. W. Bowie a member of the sectional committee for five years, *vice* A. H. Blanchard, whose term expired.

The section held meetings on January 2 and 3 for the presentation of papers. Vice-president J. A. Holmes, chairman of the section, presided on January 2, on which date the program was of a general character. Professor A. H. Blanchard presided on January 3 for two sessions devoted to papers on highway engineering. January 4 was assigned as a field or inspection day for those interested in good roads.

Retiring vice-president C. S. Howe, owing to absence on leave from Case School of Applied Science and other duties, did not present an address before the section.

The section is under obligations to the local committee and the authorities of Case School of Applied Science for the very excellent facilities for meetings; to those who, although not members of the association, contributed papers and discussions, and to those of its own membership who responded to requests for papers.

The secretary is indebted to Professor A. H. Blanchard for material assistance in the preparation of the program.

The Cleveland meeting of Section D was very encouraging to those interested, notwithstanding the storm on January 3 materially reduced the attendance.

Abstracts and titles are listed below by groups.

MISCELLANEOUS PAPERS AND TITLES

The Precise Level Net of the United States: Wm. Bowie, inspector of geodetic work, Coast and Geodetic Survey, Washington, D. C.

The Coast and Geodetic Survey has recently made an adjustment of the different loops or circuits or leveling forming the precise leveling net of the United States, which will give the most probable values for the elevations of bench marks. The datum used is mean sea level, and it is assumed that the mean levels of the Atlantic, Gulf of Mexico, and Pacific are in the same level surface. Deviations from this condition, if there are any, are not greater than the accumulated errors in a line of leveling joining any two of these bodies of water.

There are 44,720 kilometers (27,790 miles) of leveling, run in two directions, and about 10,700 permanent bench marks involved in the precise leveling. There is now precise leveling in all except seven states in the United States and the net is of such strength that the elevations resulting from the recent adjustment will probably be held as *standard* elevations for an indefinite time. This will be a great benefit to surveyors and engineers who experience great difficulties when the elevations of bench marks are changed or placed on different data. Theoretically, with each new loop added to the level net, new and better values for each bench mark may be obtained by an elaborate adjustment of the net, but the change from the old value would, in nearly all cases, be exceedingly small and insignificant, as far as engineering and surveying needs are concerned. The plan adopted by the Coast and Geodetic Survey is to hold fixed the old leveling and to fit any new sections to it. From time to time adjustments of the net will be made from which to obtain the theoretically best values of the junction points in the net, which will be of scientific interest only, and the resulting elevations would be needed for surveying and engineering purposes.

The Use of Logarithmic Coordinates in the Laboratory: D. MOOMAW, assistant professor, applied mechanics and hydraulics, Case School of Applied Science.

Presentation of diagrams, showing, on logarithmic cross-section paper, the method of determining the coefficients and exponents of curves of the second and third degrees, such as represent sometimes the relations between physical quantities in experimental work in the engineering or physics laboratory.

The observed values are plotted on logarithmic paper and the method applied simply and quickly.

The Michigan Industrial Compensation Act: G. W. BISSELL, dean of engineering, Michigan Agricultural College.

The most striking as well as the strongest feature of the law is that, except for farm and domestic help, the defenses of contributory negligence, negligence of fellow servant and assumption of inherent risks, are denied to the employer. The workingmen's compensation and employers' liability act has been in operation in this state about two and one half months, and so far the material provisions of the law and the machinery provided for its operation seem to be well adapted to carry out and make effective the general purposes of the statute. It is a well-constructed and workable act in its general features, and should be given a fair trial in its present form before any attempt is made to materially amend it. The general acceptance and approval of the law by a vast majority of the employers of labor in the state, and its approval by workingmen generally, constitute persuasive evidence that the act in its present form substantially meets the requirements and performs the functions intended.

California Electric Furnace Pig Iron: F. C. LANGENBERG, Athens, Ohio.

A brief account of electric furnace reduction in California and Sweden is given with a comparison of the practices in the two countries. A brief outline is given of the California furnace: (1) description of the furnace and electrical equipment, (2) operation and product of the furnace.

Part Two deals with a microscopic study of pig irons. Two samples of California iron are discussed and their chemical and physical properties predicted by the aid of the microscope. These predictions are confirmed by analyses. The influence of the rate of cooling on the size of the graphic flakes is also shown.

Present Status of the Gas Turbine Problem: F. C. WAGNER, professor of mechanical engineering, Rose Polytechnic Institute.

It seems probable that with the gas turbine, as in the case of the steam turbine, the most profitable field will be in large units, when large volumes can be handled with a relatively small machine. In large installations, also, it would be worth while to install apparatus for saving the heat in the exhaust gases.

Altogether the gas turbine art has made substantial progress during the past year and the outlook for practical development in the near future seems especially favorable.

Notes on Some Properties of Explosive Mixtures of Air and Gas: F. H. Vose, professor of mechanical engineering, Case School of Applied Science.

The paper refers particularly to some experiments performed with explosive mixtures of air and illuminating gas. These experiments were conducted at Washington University, St. Louis, Mo., the gas used being the illuminating gas from the city mains.

The investigation was undertaken to determine the effect of the presence of water vapor on the properties of explosive mixtures, such as pressure ratio resulting from combustion as well as the time increment involved for the completion of combustion.

While the investigation covered a wide range of mixtures, the paper was written to cover a mixture containing 4.75 parts of air to 1 part of gas by volume. This mixture approximates the theoretically best mixture for complete combustion.

Pressure rise was measured by means of the ordinary gas-engine indicator and time records obtained from tuning-fork records on the indicator card. The indicator drum was driven at a constant rate.

Slides made from original cards are shown to indicate the character of the results. Curves were also presented giving the results in graphic form.

When water vapor is present in the ratio of 0.05 parts by weight to the gas mixture a pressure ratio from explosion = 5.5 results; when the quantity of water vapor present represents 0.35 parts by weight the pressure ratio resulting from explosion is only 2.3. The retarding effect on flame propagation is correspondingly great.

The Manufacturing Organization: Hugo Diemer, State College, Pa.

Organization defined, Organization distinct from system and management, To lay out a new organization or to analyze an existing one, Numerical military type, Specialized type, Functionalized type, Staff principle applied to industry, Selecting the type or organization and control to be applied to a given industry, Determining the will of the organization as a whole, Setting forth specific duties, A typical conventional industrial organization, Department of records, Department of materials, Department of plant, equipment and processes, Routing, Scheduling, Motion and time studies, Preparing instruction, instruction cards and instruction sheets, Standardization of equipment, Department of men, Hygiene and efficiency, Psychology and efficiency, Industrial education, Development of loyalty through social and religious activities, Line organization, Progress of an order through an industrial establishment, Carrying into effect the above principles.

A Further Analysis of the Deflections and Stresses in Reinforced Concrete Floor Slabs Constructed on the Turner Mushroom System: H. T. Eddy, dean of the graduate school, University of Minnesota.

At the Washington meeting last year the present writer gave an account of his success in developing a rational analysis of this kind of flat slabs. That analysis was based upon the application of the theory of circular plates to this form of construction.

In making such application, it is implicitly assumed that any one of the panels of a slab is supported by surrounding columns in such a symmetrical manner that the central part of a panel carries its loading approximately in the same manner as a circular plate would do when suitably supported at its circumfernce. This supposition will be nearly exact at points near the center of the panel and less so the greater the distance from the center.

Again the part of the slab at and near a column head in a slab of many continuous panels will have the loading and supports so symmetrically disposed about it that it will act nearly like a circular plate with a central support at the column, at least for points near the column.

While the application of these principles was found to give sufficiently precise values of the central deflections of panels, and of the stresses at the same points, and over the columns, at other points than these the results were not and could not be expected to reproduce the results of tests. It therefore appeared desirable to develop a more closely approximate general theory of the flexure of the reinforced concrete flat slab.

The writer has had unexpected success in developing this general theory from the fundamental differential equation of flexure of slabs, by the help of which its deflections at any points are readily computed, as well as the stresses in reinforcing rods and concrete, notwithstanding the extreme irregularity of distribution of the reinforcement. This last fact requires certain hypotheses in the adaptation of the general solution for a uniform slab to the actual slab, which are proved to be admissible approximations by the agreement of actual tests with numerical computations.

Many interesting and unexpected results appear as part of this investigation whose main conclusions have been already reached. Among these is the fact that the point of maximum stress in steel is midway directly between columns and not at the center of the panel.

It is the intention of the writer to prepare and publish a treatise upon this subject after concluding his investigations upon flat slabs and upon the theory of combined beam and slab floors. These forms of construction have been ordinarily treated by American engineers by applying some form of beam theory to their computations. This has been a fruitful source of bad design and error, because in beam theory the moment of the applied forces is equal to that of the resistance of the beam,whereas in slab theory such an equality does not exist, since these may differ by 100 per cent.

It has been found that slabs are in fact perfectly safe which beam theory would regard as far otherwise. Correct theory is therefore of extreme importance in slab design.

The Significance of Empirical Tests to the Application of Explosives in Practise: CLARENCE HALL, U. S. Bureau of Mines, Pittsburgh.

Read by title.

Sampling Coal Deliveries: G. S. POPE, Washington, D. C.

Read by title.

Smoke Prevention in Cleveland: E. P. ROBERTS, city smoke inspector, Cleveland, Ohio.

A brief account of the routine of city department of smoke inspection and results accomplished at prominent plants, with locomotives and steamships.

When possible plans for boiler settings are reviewed before installation to prevent unnecessary expense to the owner.

Cleveland has noticeably improved in the matter of smoke during the past few years.

Mr. Roberts also exhibited a novel and valuable smoke chart intended to overcome the objections to the Ringelman charts.

PAPERS ON HIGHWAY ENGINEERING

Bond Issues for the Construction of State Highways: JAS. R. MARKER, state highway commissioner, Columbus, Ohio.

Read by title.

The Design of Various Types of Highway Bridges from the Standpoint of Modern Traffic: FRANK H. NEFF, professor of civil engineering, Case School of Applied Science, Cleveland, Ohio.

Subject discussed at length by the author and liberally illustrated with lantern slides.

Methods of Repairing Cement Concrete Pavements: FRANK F. ROGERS, deputy commissioner, State Highway Department, Lansing, Mich.

In practise repairs to these pavements are made by two distinct methods, depending on whether the defects are on the surface or extend deeper into the mass. Surface treatment is given by first cleaning the defective places, then filling, or covering them with hot bitumen, preferably refined tar, and coating with sand. This applies to wear at the expansion joints and to cracks caused by natural causes as well as to a pitted condition of the surface, and tends to prevent further deterioration of the places repaired. As a rule, repairs of this kind have to be made annually. In Wayne County, Michigan, the cost of such repairs has been about $50 a mile. When the defects lie deeper a portion of the concrete is chiseled out, usually to the sub grade, the exposed edges thoroughly cleaned and given a wash coat of neat cement, after which the excavation is filled with the same kind of concrete that was used in the original construction. Repairs of this kind generally prove satisfactory. Bellefontaine, Ohio, reports that repairs on 4,400 square yards of cement concrete pavement laid in 1893 and 1894 have cost only about $200.

Relative Advantages of Laying Brick Pavements on Sand Foundations and Cement-Concrete Foundations: ROBERT HOFFMAN, chief engineer, Department of Public Service, Cleveland, Ohio.

Relative economy of using a sand or concrete foundation for a brick pavement depends upon its first cost, cost of maintenance and life. Accurate data relative to maintenance and effect of traffic is not at hand. Records of cities which show the time that has elapsed between the laying and relaying of a pavement affords the best available evidence upon which to base estimates of relative economy.

In Cleveland, which is chosen as a representative city with reference to brick paving, prices paid per square yard of brick pavement, have varied as follows:

5 in. brick laid on natural sand foundation, $1.18 to $1.56.

5 in. brick on 8 in. sand or gravel ballast foundation, $1.40 to $1.97.

5 in. brick on 6 in. concrete foundation, $1.94 to $2.48.

4 in. brick on 6 in. concrete foundation, $1.71 to $2.34.

4 in. brick on 4 in. concrete foundation, $1.47 to $1.73.

During the last three years the following average price has been paid.

5 in. brick laid on natural sand foundation, $1.27 per sq. yd.

5 in. brick on 8 in. sand or gravel foundation, $1.58 per sq. yd.

4 in. brick laid on 4 in. concrete foundation, $1.60 per sq. yd.

Average life of five inch brick on sand foundation is taken from the city's experience to be fifteen years. Four-inch brick on sand foundation is assumed as twelve years. From this data it is calculated that four-inch brick can be laid on four-inch concrete as economically as the five-inch on natural sand foundation if the life will be twenty-two years. Four-inch brick can be laid on six-inch concrete as economically as five-inch brick on eight inches of sand or gravel foundation if its life is eighteen years.

It is concluded that when conditions are favorable a five-inch brick laid upon a good natural sand foundation will form the cheapest form of brick pavement, but in all other cases one with a concrete foundation will prove the most economical.

Some Considerations Affecting the Interaction of Motor-vehicle Wheels and Road Surfaces: Dr. L. I. Hewes, chief, division of economics and maintenance, Office of Public Roads, U. S. Department of Agriculture, Washington, D. C.

In this paper, the author suggests the fundamental work equation

$$\frac{h}{v}=f, \tag{1}$$

where h is effective horsepower developed at the tires of the motor wheels of an automobile, v is the velocity, and f the total resistance. This equation obtains on a level at constant speed and with the air resistance neutralized by a wind current parallel to the velocity of the machine. It is important to determine the nature of the resistance f, which is in a sense a road coefficient, as it must vary for the same automobile on different roads. The resistance to the motion above described can not be solely due to the action of gravity on the weight of the machine as much as assumption demands a constant resistance for all speeds on the same road. A table is presented showing the relation between effective horsepower, velocity and resistance of traction. This table was published in *Le Genie Civil,* Vol. LXI., No. 14, p. 276, and exhibits the relation of equation (1). It is the record of tests made in 1912 in Paris on a Berliet truck.

The author discusses two sources of resistance which must be included in the symbol f. First the resistance which is developed by the motion of the points on the automobile tire not in contact with the ground and which strike small particles with a positive forward velocity. It is pointed out that a point on the periphery of a tire moves in a cycloid and at the instant of contact has zero velocity, whereas points immediately adjacent to the periphery and not in contact with the ground move in rolling curves with velocities having considerable horizontal components which may produce small and continuous shocks, which, owing to the varying magnitude of the velocities in the same vertical cross-section, can produce twisting action upon small particles comparable to the "English" of a billiard ball and thus throw small material to one side of the path. Table of velocities of points at varying vertical distances from the road surface follows. A second source of resistance is described. This resistance is due to the fact that the pneumatic tire which is in the form of a torus is not applicable to road surfaces without deformation. The increment of tensions in the tire material due to such deformation is described and it is pointed out that such rubbing action on the road surface, while simultaneous, is continuous and the sum of such effects must cause a portion of the resistance f. The author concludes that on account of both sources of resistance it is desirable to preserve the enamel of the road surface intact and free from all loose particles, and further that the interaction of road and tire must continue unfavorable both to road and tire, unless the section of the tire is made trapezoidal.

Bituminous Surfaces on Brick Pavements: Ellis R. Dutton, assistant city engineer, Minneapolis, Minn.

The use of a bituminous coating on the surface of old and new brick paving is desirable and beneficial. It gives a more pleasing appearance to the street, reduces the noise, affords better foothold for horses—and lessens the wear of the brick.

A bitumen which would be satisfactory for this purpose should be of a very adhesive quality all the time, under all conditions of moisture and temperature, and should not become excessively

soft in hot weather—nor become brittle in cold weather.

It should be composed of such materials that would be and remain stable under all conditions and not evaporate or lose its most valuable properties.

It should be applied in the best and most approved manner, so as to produce the best results capable for the quality of the bitumen. The surface of the brick should be made perfectly clean, free from dust and moisture. The bitumen should be applied at the proper temperature—in a proper manner and under favorable weather conditions.

After application of the bitumen the surface should be covered with either fine granite or trap chips, torpedo sand or a coarse sand.

Such a bituminous coating would make the ideal brick pavement.

Small Stone Block Pavements: A. H. BLANCHARD, professor of highway engineering, Columbia University, New York City.

Illustrated with lantern slides of European and American pavements of this type.

The Organization of Town Highway Departments: FRED BUCK, assistant deputy commissioner, New York State Highway Department, Albany, N. Y.

There are three essential points to be observed in formulating any plan for the improvement of the highways of any commonwealth.

(*a*) A series of improved thoroughfares connecting the principal centers of population.

(*b*) A series of improvements to the highways which form the principal tributaries to those first mentioned.

(*c*) All highways in the commonwealth not included in the first two classes.

No plan for financing a scheme of highway improvement has yet been advanced which will make possible the improvement of a total of more than 12 per cent. of the mileage of any state, of the character indicated for classes (*a*) and (*b*) within the next 15 or 20 years; and any plan which contemplates the improvement of 12 per cent. of the mileage of any commonwealth without giving attention of some kind to the remaining 88 per cent., fails in large measure of attaining its full value to the commonwealth as a whole.

Roads comprising class (*c*), in this article, are, in the state of New York, under the jurisdiction of the Bureau of Town Highways, and since the organization of that bureau, very gratifying results have been accomplished.

With no greater town taxes than were raised under the old "Labor System," about 3,600 miles of good town macadam roads have been built, about 8,400 miles of good gravel roads, and about 50,000 miles have been properly shaped and crowned and standardized as to width.

By furnishing plans and encouraging town superintendents to construct culverts and short-span bridges with their own local labor, utilizing local materials wherever possible, in 1911 there was effected a saving, in actual cash, to the taxpayers of the state more than three hundred and fifty thousand dollars, not taking into any account the vastly superior strength and durability of the structures so erected.

The results of the plan in New York seem to clearly prove that a thoroughly organized, well equipped town highway department is one of the essential parts of any general scheme of highway improvement.

Brick Pavements for County Highways: W. C. PERKINS, Niagara Falls, N. Y.

Presented by the author, and illustrated by lantern slides.

A City Traffic Census: W. H. MESSENGER, S.B., assistant engineer, Bureau of Highways, Brooklyn, N. Y.

The above bureau inaugurated a permanent census of its vehicular traffic in June, 1912. The forms used divide traffic into two large classes, rubber-tired and iron-tired, with appropriate subdivisions of each class. Starting with a small squad of six men, working eight hours a day, rain or shine, observations have been made at some 400 points mostly in duplicate. Duplicate observations are separated by a period of 15 days. A few night and Sunday records have been taken.

Results are tabulated to give the density and tonnage. The density is computed for number per foot of roadway per minute, per line of traffic per minute, and on the basis of traffic units as used by the London Traffic Branch. Tonnages are founded on extensive inquiry among those best knowing weights of different vehicles of business and recreation, and are assembled to give daily, weekly and annual amounts per foot of width of roadway, to the end that durability or total life may eventually be found for all classes of pavement.

The results thus far obtained have been used by the city planning committee, and are daily called for in connection with the determination of the class of pavements to be laid on certain streets in the immediate future.

This census was inaugurated by Mr. H. H. Schmidt, chief engineer, and placed under the charge of the writer.

Petrographic Study of Rocks for Road-making in the Office of Public Roads: E. C. E. Lord, petrographer, U. S. Office of Public Roads, Washington, D. C.

This paper contains a review of a quantitative, microscopic method of rock analysis by means of a cross-line field, and a brief statement of the principal road-making rocks, their method of classification and physical properties. Attention has been called to the effect of mineral composition and rock structure on the wearing properties of road materials.

It has been shown that the dense, fine-grained, igneous rocks (traps) are generally more tough and offer greater resistance to wear than the coarser grained igneous, or the more loosely textured sedimentary and metamorphic rocks. In consequence of their superior toughness, the screenings from trap rocks are found to be sharper and more wedge-shaped than those from other rock types and therefore produce a more permanent bond when compacted with the larger road stones.

This interlocking of the coarser portion of the screenings with the rock fragments forming the wearing course of the road constitutes the mechanical bond of the road surface, and should be distinguished from the cementing bond of the fine dust which is due to the presence of adhesive mineral substances of a more or less colloidal character. This cementing value has been found insufficient in many cases to withstand the effect of modern traffic and it has therefore been suggested to make use of the highly cementatious basic open hearth slag dust to overcome this difficulty.

Field Methods for Laying Out Highway Curves: Henry B. Drowne, instructor in highway engineering, Columbia University.

Read by title.

The Value of Microscopic Analysis of Rocks to be Used in the Construction of Roads and Pavements: J. F. Kemp, professor of geology, Columbia University.

Read by title.

Municipal Plants for the Storage of Road Oil: William H. Kershaw, chief engineer, Paving and Roads Division, The Texas Company, New York City.

After comment on the existing conditions regarding the lack of equipment for storing road oil, with its resulting economic loss, detailed statements of the cost of tankcar equipment is given, showing that all extra expense in the handling of road oil that results from lack of proper storage facilities eventually becomes a part of the cost of the oil. Figures given show that 12,000 gallon tanks can be erected at an approximate completed cost of $700. A statement is made that the saving of the accumulating demurrage now charged by the railroads will pay for the erection of the tank and the saving in the cost of the oil will show an earning on the investment.

After describing existing municipal storage plants, a simple form of single compartment tank is suggested that will hold 12,000 gallons and is fitted with steam coils and on which all outside piping is steam jacketed, which will cost complete approximately $700 and is capable of handling all of the heavier grades of binding oils and solid bitumens as well as the lighter grades of road oil.

The Consistency of Bituminous Materials, its Determination and Value in Specifications: Major W. W. Crosby, chief engineer to the Maryland Geological and Economic Survey, and consulting engineer, Baltimore, Md.

The consistency of a bituminous material is defined as its degree of firmness and determined by internal friction.

The determination of consistency is now usually made by one or more of half a dozen instruments designed on three general principles.

The instruments described, however, do not now cover in their range the entire field of materials and some materials are difficult of measurement in the matter of consistency by any of the older and more customary instruments.

The desirability of a single instrument for the purpose, whose range will cover readily the entire field of materials, is evident. Two such, newly proposed and as yet not generally used, are described. A modification in the customary methods of performing certain tests is advocated.

The value of a proper determination of consistency is shown by the dependence, on this characteristic, of the methods of using a material, by the information which such a determination gives concerning the probable results of such use, and concerning the value of the material itself.

Specifications containing definite descriptions of

the consistency of a pitch and drawn in physical terms are particularly appropriate for physical work such as road-building, and such specifications are more likely to be readily understood than where chemical expressions are used, perhaps to cover the same points in a less direct way.

The writer believes that valuable research work can be done by investigations into the consistency of bituminous materials or pitch compounds, and that from such work the art of road-building will be advanced.

The Value of Specifications and Tests for Bituminous Materials: CHARLES S. REEVE, chemist, U. S. Office of Public Roads, Washington, D. C.

The author urges the importance of purchasing bituminous materials upon a specification. The maker of such a specification, however, should know the relations to one another of the particular characteristics he demands, and the ability of the producer to meet his requirements. Advance samples and shipments should be tested to insure the acceptance of satisfactory material and to furnish records of tests which may prove of value later. Examples of recent neglect to fulfil certain specifications are given, and in some cases this neglect would have proved serious but for the fact that careful inspection averted the use of the undesirable materials. The practise of purchasing upon a trade name only is criticized, and an example is cited which shows a recent failure due to this practise. The author concludes by urging the highway engineer to protect himself by the careful purchase and inspection of materials.

The Evaporation of Bituminous Materials, its Determination and Value in Specifications: PREVOST HUBBARD, in charge Division of Roads and Pavements, The Institute of Industrial Research, Washington, D. C.

Read by title.

Fixed Carbon in Bituminous Materials, its Determination and Value in Specifications: LESTER KIRSCHBRAUN, director, Chicago Paving Laboratory, Chicago, Ill.

The writer describes the standard method of determining fixed carbon in bitumens, and points out some of the factors of manipulation necessary of observance in order to obtain correct and consistent results. A discussion of the derivation of fixed carbon produced upon ignition of bitumens is given, and its significance applied in three particulars. First, as a means of identification of certain native bitumens; secondly, as a means of checking the suitability of combinations of flux solvents with hard, highly condensed bitumens; and again, as applied to oil asphalts, as an index of the severity of heat treatment to which such materials have been subjected in the course of their production. This latter feature is demonstrated by graphical data showing the effect upon the fixed carbon yield in runs of oil asphalt made from the same crude at different temperatures. The effect of the character of the crude from which these products are made as influencing the fixed carbon characteristics, and the application of this test to specifications, is pointed out.

A Method for Determining the Toughness of Bituminous Materials: J. E. MYERS, chief chemist New York State Highway Department, Albany, N. Y.

The toughness of bituminous materials is determined by filling a 3 oz. tin box (3.5 cm. deep by 5.5 cm. in diameter) with the melted material. The material is allowed to cool to room temperature. When cold the box is held by a pair of tongs, rapidly heated over a Bunsen burner, and the material emptied into a can of cold water. In heating, only enough heat is applied to free the material from the box, so when emptied into the water the material is still solid, being softened only on its exterior. By wetting the hands this cylindrical shaped piece of bitumen is easily rolled into a ball which will be free from seams.

The ball is maintained at the temperature at which the test is to be made (usually at zero degrees C.) for at least one hour before testing. The balls are tested in the impact machine adopted by the American Society for Testing Materials, for determining the toughness of rock used in macadam roads. The essential working parts of the impact machine are the anvil, of 50 kilograms weight; the hammer, of 2 kilograms weight, and the plunger, of 1 kilogram weight, the plunger having a hemispherical-shaped head of 1 cm. radius.

In testing asphaltic materials the drop of the hammer is taken from a height of 5 cm. for the first blow and the drop of each succeeding blow is increased 5 cm. The height from which the hammer falls when rupture occurs is given as the toughness of the material.

Distillation of Tar. Methods of Determination, and Value in Specifications: PHILIP P. SHARPLES, chief chemist, Barrett Manufacturing Co., Boston, Mass.

The methods in use and proposed for the distillation of tars and refined tars in road work are so varied and give such varied results that there is urgent call for their standardization. Attention is called to the excellent work of the Subcommittee on Distillation of Committee D—4 of the American Society for Testing Materials and their recommendations.[1]

The distillation test in a specification should be so drawn as to show, in conjunction with the free carbon, specific gravity and viscosity: (1) absence of water; (2) character of tars used; (3) method of refining. It is important that in addition to the amount of distillate, its specific gravity and the melting point of the residue be required.

Classification of Rocks Used in the Construction of Roads and Pavements: Charles P. Berkey, assistant professor of geology, Columbia University.

Read by title.

Specifications for Patented Pavements: William H. Connell, chief, Bureau of Highways and Street Cleaning, Philadelphia.

Read by the secretary.

The History of the Topeka Bituminous Concrete Pavement: Theo. S. DeLay, city engineer, Creston, Iowa.

In the early days of the use of bituminous paving surfaces various arrangements of aggregate and various bituminous materials were used, the materials and methods being adapted to the work contemplated.

About the year 1893 Marcus A. Hodgman, a paving superintendent, in the employ of F. O. Blake, in Denver, reverted to some of the earlier practises in laying bituminous pavements.

Hodgman's work was seen by Frederick J. Warren, an employee of the Barber Asphalt Paving Company, who subsequently resigned from the employ of that company, went east, and took out a patent on a similar form of construction.

Warren organized the Warren Brothers Company to promote the invention and by vigorous promotion methods succeeded in having built a very considerable yardage of paving in accordance with this method.

Hodgman died in 1903, but Blake continued in the paving business and evidently still had a good opinion of Hodgman's idea, as he promoted some pavement in accordance with that principle in Topeka, Kansas, about the year 1908.

Before this work was constructed, Warren Brothers Company brought suit for infringement of patent against the city of Topeka and the contractor. The defendants called on Blake for assistance to such good purpose that, when the case came up for trial, the plaintiff was willing to enter an agreed decree waiving claim of infringement but enjoining plaintiff against infringing.

Early in 1910 the city of Creston, Iowa, started proceedings for the construction of 25,000 yards of bituminous concrete paving and adopted the specifications used at Topeka. Creston also was made defendant in a suit by Warren Brothers Company, and this was settled by an agreed decree as in the Topeka case, but without any injunction clause.

Since it has become known that this form of pavement is free of difficulties it has been used very extensively in the middle west, with general satisfaction. It is not, however, a new form of construction, as it has been in continuous use in Pittsburgh, Pa., since 1897.

Its use has been instrumental in greatly reducing the cost of paving to the taxpayer, as may be seen by comparing prices at Creston with those of other places.

As this form of construction yields no exorbitant profits it has no promoters, hence has not met with acceptance as rapidly as its merits deserve.

It is subject to one objection common to all continuous pavements, namely, cracking under sudden changes of temperature. These cracks do no harm, show no inclination to ravel, and close up during warm weather when sufficient traffic passes to keep the pavement worked.

Economical Methods of Repairing Sheet Asphalt Pavements: H. B. Pullar, assistant manager and chief chemist, The American Asphaltum and Rubber Co., Chicago.

Read by title.

Limitations in the Use of Bituminous Carpet Surfaces: Arthur W. Dean, chief engineer, Massachusetts Highway Commission, Boston.

Read by title.

The Maintenance of Bituminous Pavements: Jas. C. Travilla, street commissioner, St. Louis.

Read by title.

Observations on Slipperiness of Bituminous Surfaces and Bituminous Pavements: W. D. Uhler,

[1] *Proceedings of the American Society for Testing Materials,* Vol. XI., 1911.

assistant chief, Bureau of Highways and Street Cleaning, Philadelphia.

Read by title.

The Mixing Plants Used in the Construction of the Topeka Bituminous Concrete Pavements of the Borough of Queens in 1912: A. F. GRUENTHAL, assistant engineer, Bureau of Highways, Borough of Queens, N. Y.

Read by title.

Bituminous Gravel Concrete Pavements: SPENCER J. STEWART, division engineer, New York State Department of Highways, White Plains, N. Y.

This pavement consists of mixing Hudson River cementatious gravel, heated to a temperature of over 225 degrees F., with natural lake asphalt heated to a temperature of not less than 275 degrees F., then placing both ingredients in a mechanical revolving mixer and thoroughly agitating until all the particles of the mineral aggregate are thoroughly and completely coated with the bituminous material.

This mixture, at not less than 250 degrees F., is then spread upon the prepared bottom or foundation course.

The gravel is composed of calcareous sandstone, granite and quartzite, associated with a considerable amount of finer particles of the above-named rocks, together with a percentage of clay. This latter substance gives the gravel a good cementatious value, which is an essential to the comparative permanency of the pavement. The clay acts as a catalyzer on the asphalt, making it more viscous, less volatile and also less brittle.

The advantages of this pavement are:

First, its comparatively low cost over so-called semi-permanent pavements.

Second, on account of its adaptability to country and parkway purposes, due to its easy riding surface and its conformity to our ideals of the surroundings of a parkway or country highway.

Third, on account of its non-slippery nature, it being practically a "non-skid" road.

From the contractor's bids, the average cost of this pavement is about $0.85 per square yard.

A Review of the Use of Bituminous Materials in the Construction and Maintenance of American Highways during 1912: ARTHUR H. BLANCHARD, professor of highway engineering, Columbia University, New York City.

G. W. BISSELL,
Secretary

EAST LANSING, MICH.,
March 10, 1913

SOCIETIES AND ACADEMIES

THE HELMINTHOLOGICAL SOCIETY OF WASHINGTON

THE fifteenth regular meeting of the society was held at the residence of Dr. Ransom, March 20, 1913, Dr. Ransom acting as host and Mr. Chambers as chairman.

The comparative anatomy of the free-living and the parasitic nematodes was discussed by the society.

Mr. Crawley presented a note reviewing Muriel Robertson's work on *Trypanosoma gambiense* and its vector, *Glossina palpalis*. She has shown there is a rhythmic cycle in the life of the trypanosome in the vertebrate host, the parasite falling off in numbers at times until there are only a few small forms present, which then begin to multiply with a resultant production of larger forms until the blood contains numerous large forms, and the cycle repeats. An endeavor to correlate this alternation of few small forms and numerous large forms with the infectivity of the trypanosomes for its invertebrate host, the tsetse fly, developed the fact that the infectivity was at its maximum when the few small trypanosomes were in the blood and at its minimum when the many large forms were present.

Dr. Ransom presented a note on "The Reported Hosts of *Cysticercus cellulosæ*." It is commonly stated in general works on parasitology that *Cysticercus cellulosæ* occurs not only in the pig, its usual host, and in man, a not uncommon host as a result of auto-infection, but also in the dog, cat, bear, sheep, deer, rat and monkeys. It has also been reported from a seal.

The only hosts, however, in which the occurrence of *Cysticercus cellulosæ* can be considered to have been proved are the first three named. The reputed occurrence of *C. cellulosæ* in the cat, bear, rat and seal rests apparently upon a single instance of the discovery of cysticerci resembling *C. cellulosæ* in these hosts without proof by feeding experiments. Likewise, though several cases of *C. cellulosæ* have been reported from monkeys and rather many cases from sheep and deer, no experimental proof or other evidence of a conclusive nature that the parasites in question were really *C. cellulosæ* has been furnished. On the contrary, the evidence thus far available tends to prove the non-occurrence of *C. cellulosæ* in these animals, particularly in the case of sheep and deer. It has, in fact, been recently shown (Ransom, 1913) that the muscle cysticercus of sheep

resembling *C. cellulosæ* is the intermediate stage of a dog tapeworm; consequently very definite and detailed evidence must be produced before any case of cysticercus in sheep can be accepted as a case of *C. cellulosæ*. Similarly, more definite evidence than has been furnished in the various reported cases of muscle cysticerci in deer will be required before any such can be accepted as a case of *C. cellulosæ*. Though it is perhaps not surprising that the muscle cysticerci of sheep should have been accepted as *C. cellulosæ* in view of the fact that sheep commonly live in rather close relationship with human beings, it does seem, on the other hand, surprising that the reports of cases of *C. cellulosæ* in deer should not have been questioned heretofore. Furthermore, it would seem, in view of the fact that it has long since been shown (Moniez, 1879) that the cysticerci in reindeer somewhat resembling *C. cellulosæ* are the larvæ of a dog tapeworm, that observers of cysticerci in other deer would have hesitated to identify them as *C. cellulosæ*, yet no one appears to have doubted the correctness of such an identification. Even in certain cases in which it was noticed that the hooks did not correspond perfectly to those of *C. cellulosæ* the observer nevertheless concluded that the parasites were actually *C. cellulosæ*. The history of *C. cellulosæ* emphasizes the necessity of guarding against the indiscriminate acceptance of host records. As a general rule records of the same species of larval tapeworm from a variety of hosts should be considered of doubtful correctness unless supported by feeding experiments or other conclusive evidence.

Maurice C. Hall,
Secretary

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

A special meeting of the society was held at 4:30 P.M. on March 25, 1913, in room 43 of the new building of the National Museum, the president, Mr. Stetson, in the chair.

Dr. George Grant MacCurdy read a comprehensive paper on "Ancient Man, His Environment and Art."

This paper dealt with the environmental factor in human development; the newly discovered human remains from Piltdown, Sussex, and their significance; recent finds in the terraces of the Somme Valley; San Isidro, near Madrid; Torralba, a large camp site in the province of Soria, Spain, where a rude stone industry associated with an ancient fauna has been found; caves on the Island of Jersey occupied by Mousterian man; typical caves and rock shelters of southern France: La Quina, La Ferrassie, Placard; the art of the cave man in France and Spain: Altamira, Castillo, La Pasiega, Covalanas, Pindal, Font-de-Gaume, Cap Blanc, Niaux, Gorgas, Laussel, Alpera, Cogul; representations of the human form; La Combe, a cave in the Dordogne excavated last summer by Professor MacCurdy; Tuc d'Audoubert, a Pyrenean paleolithic cavern of great beauty discovered last July; its parietal art and the unique figures of the bison modeled in clay; paleolithic art in its relation to magic; some of the causes which led to its development and eventually to its decay.

The lecture is based largely on first-hand observations by the lecturer during the past summer. The lantern slides reproduce faithfully in color the remarkable paleolithic cavern frescoes. The epochs covered by the lecture beginning with the oldest are: Eolithic or pre-Chellean, Chellean, Acheulian, Mousterian, Aurignacian, Solutrean, Magdalenian and Azilian. These are all pre-Neolithic.

Several questions were asked and answered.

W. H. Babcock

THE CLEMSON COLLEGE SCIENCE CLUB

The regular monthly meeting of the club was held on Wednesday evening, January 15. The first paper was by Dr. R. N. Brackett, head of the department of chemistry, entitled "The History of the Clemson College Science Club." There was a great deal in this that was very interesting, as Dr. Brackett presented same in a very entertaining manner and pointed out that the club had entertained and had before it some distinguished men in its history.

The next paper of the evening was by Professor J. N. Harper, director of the agricultural department and of the South Carolina Experiment Station, on the "Mendelian Law." This was treated from the standpoint of his own experiments and observations on this law. He very lucidly gave the history of Mendel and the explanation offered by him for the operation of his law. It is of decided interest also that Professor Harper has done original work along this line and has evolved an explanation for the working of the law that has invariably been borne out in his observations and experiments.

F. R. Sweeny,
Secretary